POWER

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Man's Youngest Servant—Electricity

IT IS not yet a half century since electricity began its broader service to man.

At the Centennial Exposition fifty years ago a generator and an arc lamp were exhibited, but nothing that would have inspired in the most active imagination a vision of the miracles that electricity has since performed.

Up to that time its service had been mainly in telegraphing and the current was supplied by roomfuls of primary batteries.

Then came the development of the arc light and the machines for generating it; then the incandescent light and the subdivision and distribution of centrally generated current into factory, office, store and home.

At first used largely for lighting, the possibilities and applications of this mobile and easily manageable form of power soon became obvious. The plant installed to lighten the hours of darkness was operated to furnish power for the activities of the day.

We were reaching the limits in width and speed of belting when it became possible to take off the entire output of the largest engine through a single cable and distribute it through all the ramifications of a service to the minutiae of application.

How would the output of a 100,000-hp. turbine be taken off and distributed if it were not for electricity?

The availability of this form of power through the simple pushing of a button or the throwing of a switch has led to the invention and development of many devices whereby the work of the executive, the artisan and the housewife is lightened and the burden of providing the necessities and comforts of life shifted from human shoulders to tireless copper and steel.

Many crude, inefficient power plants have been shut down and their power generated collectively more cheaply and conveniently in a station or system of stations the design and operation of which comprise the best brains and talent that money can hire and scientific training supply.

But many plants have been shut down that could produce current more cheaply than can any central station and more coal is being burned than as though they had been allowed to continue to run.

The industry that has in a half century wrought the wonders that the public utilities devoted to the generation and distribution of electricity have done has such an opportunity for real service, has so broad a field for legitimately helpful activity that it has no need to stultify itself and desecrate its higher purposes by violating the principles of sound engineering in ill-considered efforts on the part of its commercial staff to extend its business to situations where it does not economically belong.

Western Electric Co.'s Power Plant at New Kearny Works

Plant Designed for 20,000 Kw. Generating Capacity, Condensing, Non-Condensing and Mixed Pressure Turbines Used—Forced Hot Water Circulation Used for Heating All Buildings—Small Sized Anthracite Used as Fuel

TO MEET the demand for cable and telephone apparatus the Western Electric Co. laid plans early in 1923 for a plant to supplement its large Hawthorne Works at Chicago, Ill. Construction work was started during 1924 and the first section of the plant was put into operation about August, 1925.

The plant which embodies the most modern practice in the production of telephone apparatus is situated on a 60-acre tract of tide-water marsh land bordering on the Passaic River near its confluence with the Hackensack River at Kearny, N. J. If present plans are carried out the ultimate plant will have over 3½ million sq.ft. of floor space and employ in the neighborhood of thirty thousand people. The initial development consisting of buildings with about one million sq.ft. of floor space is now nearing completion. The plant is electrically driven throughout, power being supplied by a steam-turbine power station adjoining the plant.

All of the buildings, including the power station, are of structural steel frame and pressed face brick construction on pile and concrete foundation. Owing to the character of the soil, a large amount of work was involved in laying the foundation, it being necessary to drive piles over the entire building area. The power station building is approximately 181 ft. wide and 100 ft. long, divided into two sections, boiler room 92 ft. wide and turbine room 89 ft. wide. A coal- and ash-handling building is located between the west side of the main building and the river and connects with the latter by an overhead bridge. The present installation of steam and power generating equipment consists of four 8,000-sq.ft. boilers fired with No. 3 buckwheat and three generating units having a total capacity of 8,000 kw.

The lower portion of the interior walls of the turbine room are faced with glazed tile of buff color. The upper portion of the wall, as well as the interior walls of the boiler room, and boiler settings are of pressed face brick. Liberal daylight illumination has been provided for throughout the plant. In determining the manner of firing the boilers a number of methods were considered including underfeed stokers for bituminous coal, traveling grate stokers for small sized anthracite and the methods of firing coal in pulverized form. Firing with fuel oil was considered, but not adopted, as the price of oil at the time appeared prohibitive when compared with the cost of firing with coal. Due consideration was given to pulverized coal firing but upon investigation it was found that the chief argument in favor of this method of firing, the ability to use low-grade fuel, did not necessarily apply in this case, as the distance from the coal mines and the resulting transportation charges were against the use of this fuel. And inasmuch as the difference in boiler efficiency between burning a good grade of coal in pulverized form and on stokers is comparatively little, it was decided to install stokers. This reduced the problem to a choice between the use of bituminous and small-sized anthracite coal. The latter was the cheaper of the two and had the further advantage of greater cleanliness, an important consideration. It was therefore chosen but the stokers purchased can be used for both kinds of coal.

Provision is made in the layout of the coal-handling equipment to permit the receiving of coal by rail, barge or truck and the disposing of the ashes in the same way. As will be seen in Fig. 1 duplicate tracks run over the unloading hoppers in the base of the coal- and ash-handling building. For receiving coal by barge a telescopic hopper is provided on the river side of the building and the coal is handled between the barge and the hopper by a locomotive crane. When not in use the hopper folds up flush with the wall of the building. From the unloading hopper below the tracks, the coal, after passing through a single-roll crusher, is carried by duplicate bucket conveyors to a concrete bunker above the boilers. One conveyor is arranged for discharging the coal to a chute that passes the coal through the building wall to a point in the storage yard from which it is distributed over the storage pile by drag scraper, the operating house for the scraper being shown in the foreground in Fig. 1. The coal is reclaimed from storage by the same scraper equipment and discharged to a loading hopper; from the hopper through a crusher to a flight conveyor which in turn delivers it to the bucket conveyor.

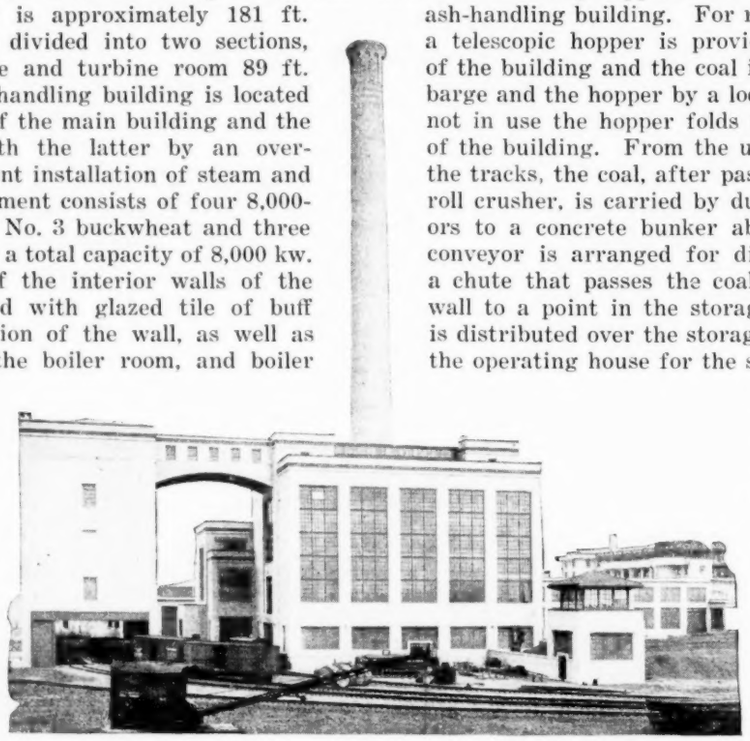


Fig. 1—View of power plant at the Kearny Works

The present boiler installation consists of four 8,000-sq.ft.

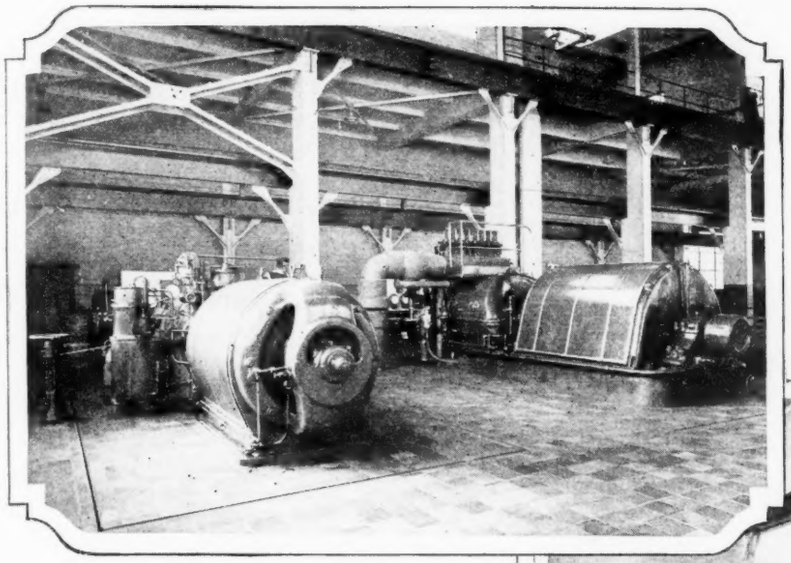


Fig. 2, Left—Turbine room showing 1,500-kw. mixed-pressure and 5,000-kw. condensing units

Fig. 3, Below—Steam-driven exciters and feed pumps with 1,500-kw. non-condensing unit in background

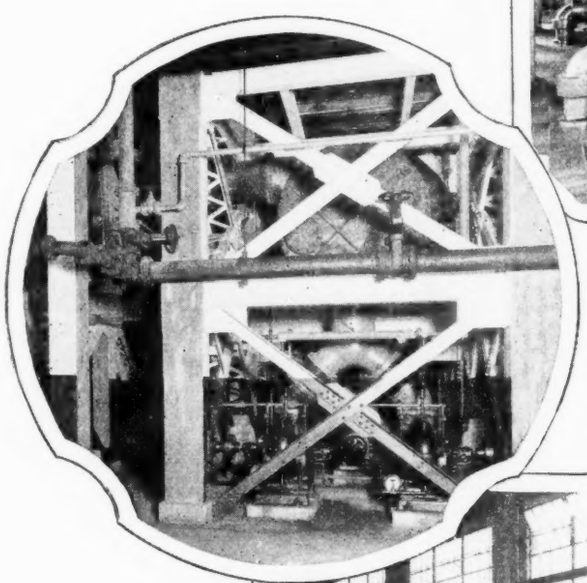
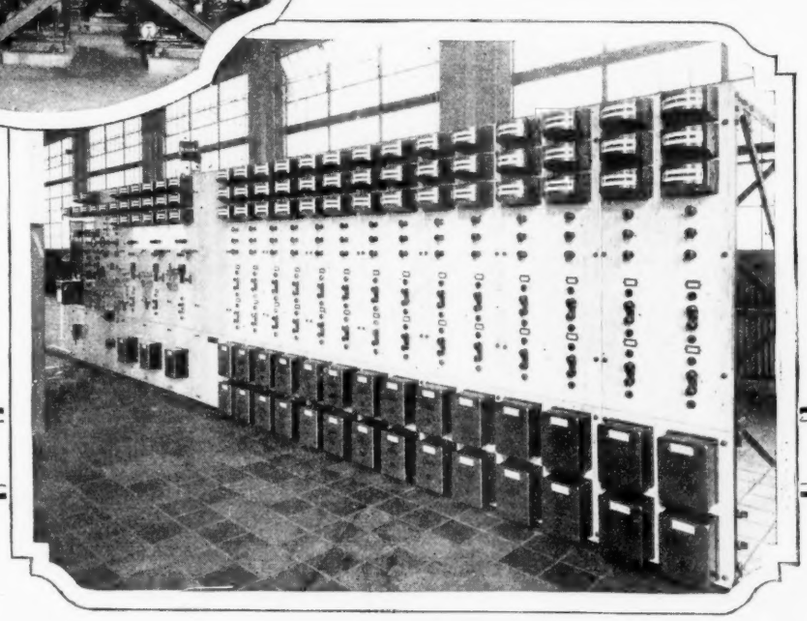


Fig. 4, Left—Condenser and auxiliaries are contained within the structural steel foundation

Fig. 5—Switchboard contains regulator, temperature indicating, exciter, generator and feeder control panels



Generating Equipment and Some of the Auxiliaries

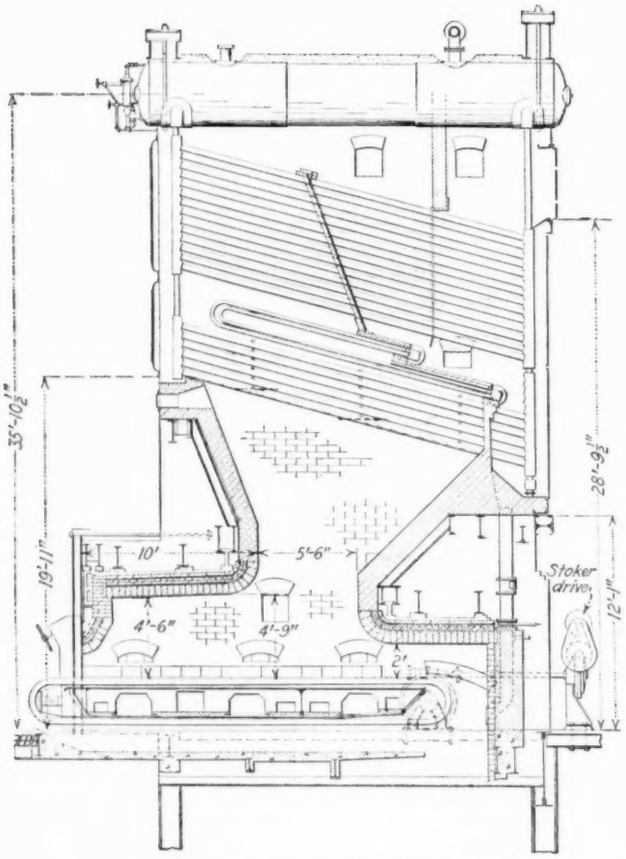


Fig. 6—Cross-section of boiler settings

water-tube boilers, each having a 1000-sq.ft. superheater located above the sixth row of tubes. They are fired with forced-draft traveling-grate stokers having an active area of 195.5 sq.ft. each, giving a ratio of water heating surface to grate area of approximately 40 to 1. In the design of the furnace liberal combustion space has been provided to permit operating the boilers up to 300 per cent of normal rating. In addition to the usual ignition arch at the front a long arch is built over the rear of the stoker to divert forward the products of combustion and the excess air that is required in that area, tending to mix it more thoroughly with the products from the front of the grate and thereby reduce the losses due to stratification of the gases. Air-cooled blocks are placed in the side walls of the furnace at the stoker level to minimize slag formation. The center wall of each battery is also air cooled.

Air for combustion is supplied by four turbo-vane fans located on a mezzanine floor below the firing aisle. The wind boxes below the stoker are divided into three compartments lengthwise of the grate and two compartments crosswise of the grate, permitting a close regulation of the air over the entire grate area. The pressure in each compartment is controlled by means of a slide gate in each branch coming off the main duct. The stokers are driven from the rear by d.c. motors through double-reduction worm gears. Steel-plate breechings lined with 2-in. insulation connect the boilers to a radial hollow-brick stack 12 ft. 6 in. in diameter at the top and 258 ft. in height above the grate. The stack is superimposed on the building steel at roof level. The cross-sectional area of the stack at the base is 0.197 sq.ft. per square foot of grate served. The base of the stack is provided with a soot chamber from which a 7-in. pipe is run to a convenient point in the ash-loading alley. Provision has been made in the building design for the installation of economizers if these later prove desirable.

The refuse which passes over the rear end of the grate falls directly into a brick-lined ash pit from which it is discharged through hydraulically operated gates to the bucket conveyor and delivered to a 700-ton concrete ash hopper in the coal- and ash-handling building. From this hopper the ashes can be delivered to trucks, railroad cars, or to a bin on the river side of the tower from which they are transferred by locomotive crane to a barge.

Although the boilers are designed for a working pressure of 300 lb. they are operated to give 275 lb. and 200 deg. superheat at the turbine throttle. The boiler

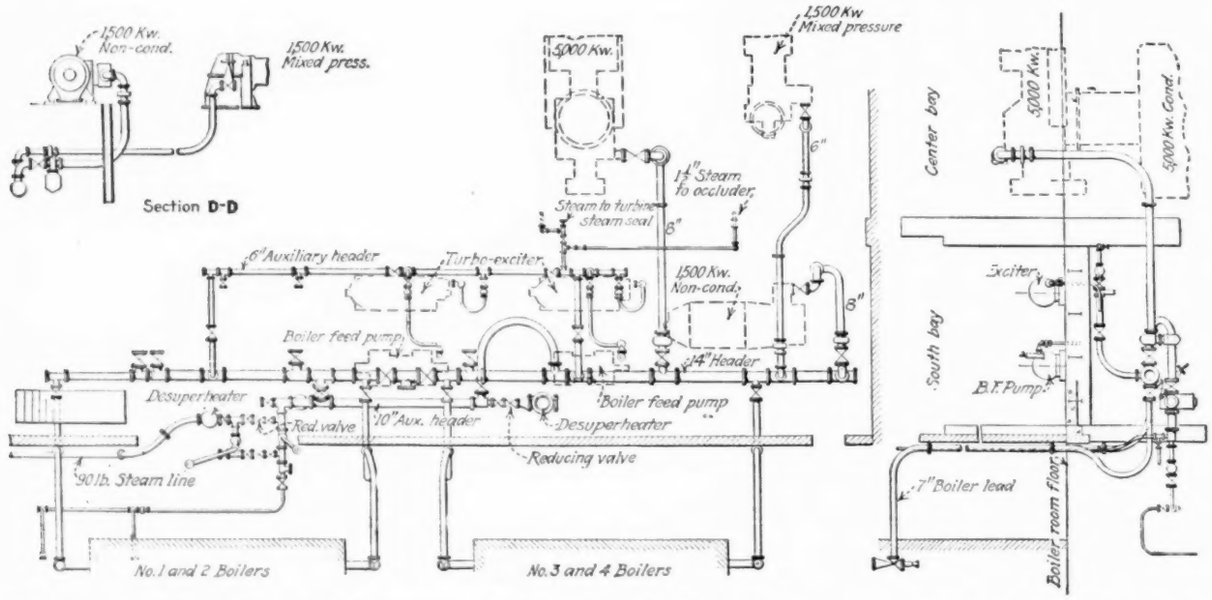


Fig. 7—Diagram showing high-pressure piping layout and arrangement of generating units and auxiliaries

nozzles are connected through 7-in. loops with a 14-in. main steam header, from which the steam is taken for the main units and two auxiliary headers supplying steam to the station auxiliaries, and through reducing valves and desuperheaters to a 90-lb. process steam line to the factory. An additional connection is made from one of the auxiliary headers through a reducing valve and desuperheater to the main exhaust header, to supplement the normal supply of exhaust steam for the various services should this become necessary. All high-pressure lines have Sargol joints, and all-important stop valves as well as the sectionalizing valves in the headers are motor-operated.

The generating equipment at present installed consists of one 1,500-kw. non-condensing turbo-generator unit, one 1,500-kw. mixed pressure and one 5,000-kw. condensing unit. The mixed pressure and the 5,000-kw. units are located in the center section of the turbine room while the non-condensing unit together with turbo-driven and motor-driven feed pumps and exciters are in a side bay. The switchboard and the switching and feeder equipment are in a bay at the other side of the main turbine floor.

Three-phase, 60-cycle current is generated at 460 volts and distributed by a four-wire system, the lead sheath of the cables being used for the grounded neutral. Excitation for the generators is furnished by two steam-driven exciters and one motor-driven unit, any one of which will take care of the excitation for all the generators. One of the units is used to supply current for operating the stoker motor and a few direct-current motors in the factory. All other motors are three-phase alternating current, the one driving the air compressor, ice machine and battery charging sets being of the synchronous type.

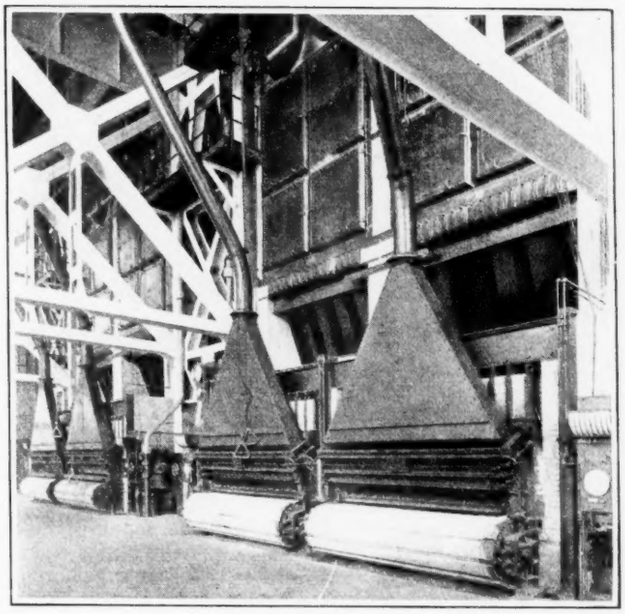


Fig. 8—View down firing aisle showing four 8,000-sq.ft. boilers fired with traveling-grate stokers

Each generating unit complete with surface condenser is supported on structural steel foundations, and the condensing auxiliaries are contained within the foun-

DATA ON THE PRINCIPAL EQUIPMENT IN THE KEARNY PLANT, WESTERN ELECTRIC CO.

BOILERS

Manufacturer	Babcock & Wilcox Co.
Size and type	8,000-sq.ft. horizontal water tube
Number installed	Four
Superheater	1,000 sq.ft.
Coal burned	No. 3 buckwheat

STOKERS

Manufacturer	Combustion Engineering Corp.
Size and type	195. 6-sq.ft. (Coxe) traveling grate
Drive	5-hp. motor through double reduction worm gear
Draft	Natural and forced draft below grate

FORCED DRAFT FANS

Manufacturer	B. F. Sturtevant Co.
Number installed	Four
Capacity, cu.ft. per min. against 4 in. water pressure	35,000
Drive	40-hp. motor

CHIMNEY

Builder	Alphons Custodis Chimney Construction Corp.
Type	Radial brick
Diameter at top, ft	12.5
Height above grate, ft	258
Boiler breechings	Connery & Co.
Breeching lining	Johns-Manville, Inc.

BOILER FEED PUMP AND HEATERS

Manufacturer	Wheeler Condenser & Eng. Co.
Number	Two
Type	4-stage centrifugal
Capacity, gal. per min	400 at 365 lb.
Drive	150-hp. Sturtevant turbines
Heater, de-aerator type	Elliott Co.
Capacity, pounds per hour	150,000

COAL AND ASH HANDLING

Two bucket conveyors, 85-ton capacity	Link-Belt Co.
Two crushers	R. H. Beaumont Co
Apron feeder and flight conveyor	R. H. Beaumont Co.
Storage and reclaiming equipment	R. H. Beaumont Co.
Locomotive crane	Brown Hoisting Machinery Co.
Switching locomotive	General Electric Co.

GENERATING EQUIPMENT

Manufacturer	General Electric Co.
Type and size	One 1500-kw. non-condensing, one 1500-kw. mixed pressure, one 5000-kw. condensing
Pressure at throttle, lb. gage	275
Superheat at throttle, deg. F	200
Generator	3-phase, 60-cycle, 460 volts
Exciters	Three 75 kw.
Drive	Two G. E. turbines, one G. E. motor
Generator air cooler	General Electric Co.
Switchboard and electrical equipment	General Electric Co.

CONDENSER

Manufacturer	Wheeler Condenser & Eng. Co.
Type	Spiro-flow surface
Circulating pumps (three centrifugal)	Wheeler Condenser & Eng. Co.
Condensate pump (four centrifugal)	Wheeler Condenser & Eng. Co.
Air pumps—steam ejectors	Wheeler Condenser & Eng. Co.

MISCELLANEOUS EQUIPMENT

Furnace arches	Liptak Fire Brick Arch Co.
Carborundum blocks	Bernitz Furnace Appliance Co.
Soot blowers	Diamond Power Specialty Corp.
Feed-water regulators (Copes)	Northern Equipment Co.
Boiler meters	Bailey Meter Co.
Feed water meters	Simplex Valve & Meter Co.
High-pressure valves	Chapman Valve Mfg. Co. Edward Valve & Mfg. Co.
Low-pressure valves	Chapman Valve Mfg. Co. Crane Co.
Automatic non-return valves	Schutte & Koerting Co.
Reducing valves	Foster Engineering Co. Ruggles-Klingemann Mfg. Co.
Back-pressure valves	Atwood & Morrill Co.
Steam trap	Crane Co. Strong, Carlisle & Hammond Co.
Pipe covering	Philip Carey Co.
Blow-off valves	Everlasting Valve Co.
Safety valves	Consolidated Safety Valve Co.
Heater, heating system	Wheeler Condenser & Eng. Co.
Circulating pump, heating system (4,000 gal.)	Wheeler Condenser & Eng. Co.
Recording gages, thermometers	Taylor Instrument Co's. American Schaeffer & Budenberg Corp.
Electric cranes	Shaw Electric Crane Co.
Air compressor	Ingersoll-Rand Co.
Refrigerating system	Shipley Construction Co.
Oil filtering system	S. F. Bowser & Co.
Fire pumps, 1,500-gal	Lecourtenay Co.
Fire pump drive	150-hp. Sturtevant turbine

dation proper. The circulating and condensate pumps are in duplicate and steam jet air ejectors with after-condensers are used for air and vapor removal. Circulating water from the river is carried through concrete tunnels beneath the turbine room floor.

The condensate from the condenser is discharged through a common header to a surge tank located just under the roof at one end of the boiler room. From the surge tank the water returns by gravity to the de-aërator and heater.

As previously mentioned, the entire plant, including the power plant, is heated by a forced hot-water circulating system. The water is heated by exhaust steam in a vertical heater in the turbine room basement, and is circulated through this system at 100 lb. pressure by single-stage centrifugal pumps. The heater is designed to heat 3,000 gal. of water per minute from 170 to 200 deg. with steam at atmospheric pressure.

All drinking water for the entire plant is maintained at a temperature around 50 deg. by passing it through a brine cooling tank. The water is circulated through the system under 100-ft. head by two-stage centrifugal pumps.

The design and supervision of construction of the plant were carried out under the direction of the company's engineers by the J. G. White Engineering Corporation.

The Joys of Operating a Stand-by Plant—III*

By "THE CHIEF"

SPONTANEOUS combustion in coal piles has always been more or less annoying. The more and larger the piles the more trouble you are apt to have. I use the phrase "apt to have" because there are no hard-and-fast rules governing fires in coal piles. If you submerge coal under water you will not be bothered with fires, but not many of us are situated so that we can store coal in this manner.

I did not start in to talk about the storage of coal, so will get back to my subject of fires in coal piles. At this plant we have them some years and some years we don't, but a couple of years ago we shut down earlier than we had expected and got caught with a lot more coal on hand than we would have had if we had run the usual time. You can never guess what a water-power plant is going to do to you. We were bothered with fires before we shut down, but were able to keep ahead of them by digging them out as soon as they showed up, putting the coal in the bunkers and burning it up in the furnaces.

When shut down, this was a different story; it was a case of dig and bury, bury and dig all season long, with the fires always in the lead. Coal piles were shifted from one part of the yard to another, turned upside down and downside up; then it was done all over again, and then some more. This was a regular part of our daily dozen, and the biggest part at that.

When we started running again we had a beautiful mixture of coal, coke, clinkers and ashes to "burn." We surely did have a picnic, but we had to burn it, and burn it we did. On days when the load was light we got away with it in good shape, but our load runs all over the lot, one day light, the next heavy, and so on—we can never tell what the morrow will bring forth. On the days when it was heavy it was some job—clinkers as big as the Woolworth Building (or nearly so). I learned how to swear in nearly every language that they swear in except English. At night when the firemen said their evening prayers I can imagine what they asked the Lord to do to that coal, and I haven't any doubt that those prayers helped, for we eventually got rid of it and got back to normal. I hope we never get a mess like that again, and will not blame the firemen for cussing a little if we do.

A while back I said you can never tell what the morrow will bring forth. We are not supposed to cover the system at night, as the base-load stations have room to spare after the factories and shops are shut down, so we can fold our faces and hands and go about our business in our own way. However, we keep a record or rather a directory of the men with address and phone number (if they have a phone), and when I go out at night I usually tell some one where I can be found. One night, due to a heavy thunder shower and high wind, the high-tension lines got mixed in such a way that the new plant had to carry most of the system and was nearly swamped, calling on the old stand-by to give a hand. They pulled me out of a movie house and also got hold of the boiler-room foreman. We picked up two or three men and in a few minutes had the old mill rolling. As soon as the operator on watch had put in a call for several men and had reached us two he started warming up a turbine and had the water tender build up the fire in the one boiler steaming, which was all that was needed.

By the time we arrived at the plant the only thing to do was to "go" and we "went." The line trouble was straightened out by daylight, and there being no further need for us, we took a sneak and went home to bed, so that we could go to see the rest of that movie the next evening.

However, they changed pictures that day, so I was out of luck, and never did see it, and don't suppose I ever shall.

(To be continued)

*Installment I appeared in the March 16 issue, and Installment II in the March 30 issue.

THE ATMOSPHERIC RELIEF VALVE is the safety valve of the condenser. If it fails to operate in an emergency, full boiler pressure can be applied to the exhaust casing of the turbine and to the condenser shell. Of course the casing will explode, with disastrous results. To avoid this, relief valves are usually designed and built so that they are almost sure to open upon loss of vacuum. Failures are rare indeed. However, it is well for the engineer to operate such valves periodically when shutting down the machine. The second function of the relief valve is to keep air out of the vacuum system. To this end such valves are often arranged to be water-sealed, but if adequate water is not supplied constantly or at least regularly, such provisions are useless. Since the main turbine or engine steam rate is sensitive to exhaust pressure and since condensers are sensitive to air leakage, attention to the atmospheric relief valve is of great importance. It must be tight when shut, and yet must open promptly when the vacuum breaks.

Recent Developments in High-Speed Turbo-Alternators

Describes a 3,600-r.p.m. 12,500-kva. Turbine-Driven Alternating-Current Generator and Shows How the Ventilation Problem of This Machine Was Solved

By M. D. ROSS
Power Engineering Department, Westinghouse Electric & Manufacturing Company

WITHIN the last ten years the maximum possible turbine-generator rating that could be built at any given speed has increased rapidly. In 1915 the largest 1,800-r.p.m. 60-cycle turbine generator then under construction was about 20,000-kva. capacity and the largest 3,600-r.p.m. 60-cycle machine about 6,250 kva. Several 62,500-kva. 1,800-r.p.m. generators are now under construction in this country, and a 12,500-kva. 3,600-r.p.m. generator was placed in service during the early part of 1925.

These increases in size have been made possible by better materials, improvement in shop methods and a better knowledge of the factors involved in the design of such machines. The 12,500-kva. 3,600-r.p.m. generator represents a big step in advance in the smaller-sized 60-cycle machines, as the largest 3,600-r.p.m. machines built previously were rated at 7,500 kva. There is considerable advantage in using a 3,600-r.p.m. unit at this rating because the cost and weight of the turbine generator will be less than for the 1,800-r.p.m. unit, while the performance of the two will be about the same.

Some years ago a 3,600-r.p.m. turbine generator with a rating of 12,500 kva. was considered impossible. At that time the rotor diameter of large two-pole machines had increased to about the maximum as limited by rotor stresses. Increase in rating would then have to be obtained by lengthening the machine, keeping the same rotor diameter. Lengthening the existing machines would have involved difficulties due to ventilation of the stator and rotor. If all the ventilating air had to be taken in through the air gap, the pressures required to force through a sufficient amount would have been excessive. The distribution of this air in the radial vent ducts would have been poor, as there would be little air flowing through the vents near the ends of the machine. Temperature difficulties would also have been encountered if air were carried through axial ducts in the back of the core to vent ducts at the middle of the machine, as in an axial ventilated generator. In this case the middle of the machine would be hot owing to the length of core to be ventilated.

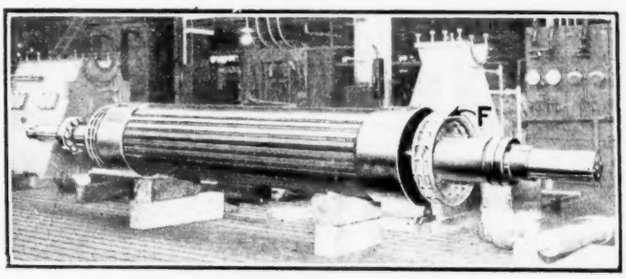


Fig. 2—Rotor of 12,500-kva. 3,600-r.p.m. alternator

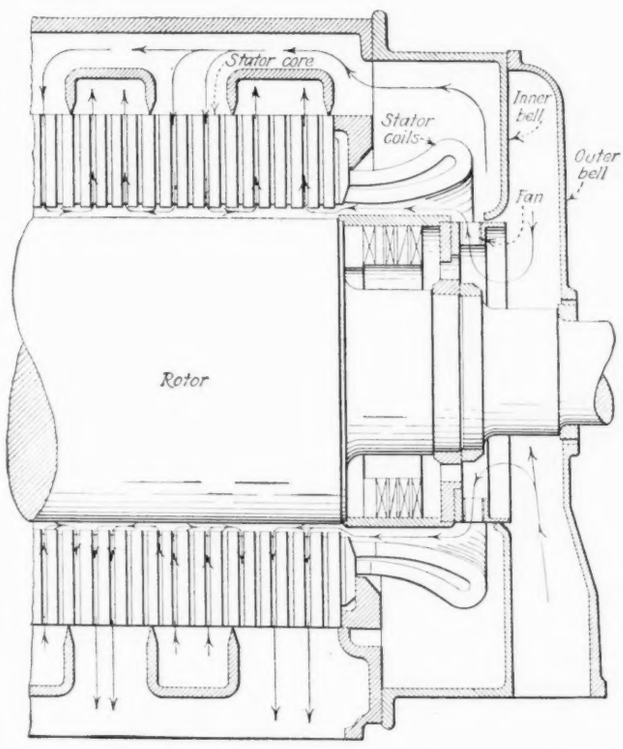


Fig. 1—Method employed in ventilating the high-speed turbo-alternator, Figs. 2 and 3

The difficulties with ventilation were overcome in the 12,500-kva. generator by using the multiple-path radial system of ventilation. This system is shown diagrammatically in Fig. 1. Air under pressure in the end bells is carried axially across the back of the core in passages cored in the frame, passes radially into the air gap through radial vent ducts in parts of the core, travels axially through the gap and out of the frame through radial vent ducts in other sections of the core, as indicated by the arrows in the figure. Air from the end bells is also fed into the gap at the end of the rotor. Using this scheme, the ventilation of a long core is a relatively simple matter. If a longer core is required, more air intake belts are provided. The intake and dis-

charge belts can be proportioned so that nearly uniform cooling of the core at all points can be obtained.

In large 3,600-r.p.m. generators the rotor diameter is made as large as is considered feasible as limited by stresses in the materials. Only the best grade of materials can be used for these rotors. The rotor of the 12,500-kva. turbine generator is a single high-grade forging with radial slots machined in it. The rotor winding is held in place in the slots by non-magnetic steel wedges and the coil ends are held by high-grade

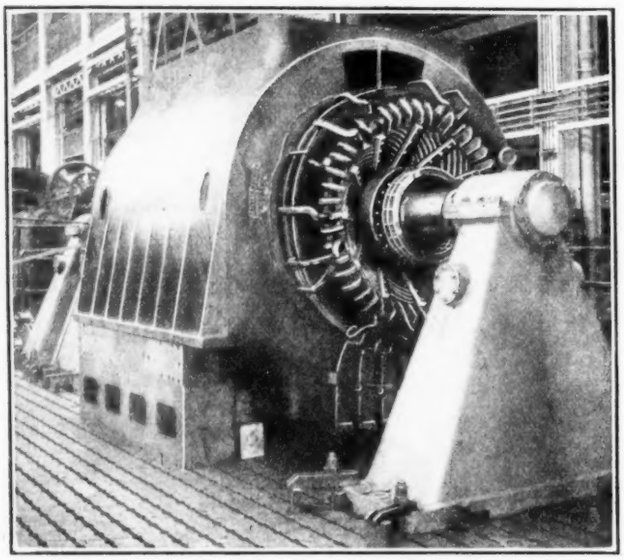


Fig. 3—Stator of alternator on test floor with end bells removed

forged-steel retaining rings. It will be noted from Fig. 2 that the ventilating fans *F* are mounted on the rotor.

In a two-pole machine with long stator-coil ends and relatively low inherent reactance, the end windings must be well braced to withstand short-circuits. Fig. 3 shows the machine with end bells removed. The coil ends are supported with metallic triangular shaped braces bolted to the end plates at frequent intervals around the circumference. The inner side of each support is parallel to the outer conical surface formed by the coils, affording a long line of contact. Strips of treated wood separate the coils from the ground support and from each other and serve to clamp the winding to the metallic support. Insulated bolts hold the wood blocks in place. Wood blocks are roped between coil ends adjacent to the armature-end plates to support the straight part of the coil beyond the slot. This method of supporting the coil ends has been found satisfactory under the most severe operating conditions.

Wherever possible mica is used to insulate the stator and rotor coils. Mica is used to insulate the rotor turns from one another and to insulate the coils in the rotor slots. The rotor-coil ends are insulated from the retaining rings with mica. The stator coils are insulated on the straight part with a machine-wrapped mica cell and on the coil ends with treated tape to provide the necessary flexibility in the insulation of the coil ends to withstand the bending incident to winding. The insulation on the individual strands and between conductors on the stator winding is mica tape throughout the whole length of the coil.

As in all Westinghouse 3,600-r.p.m. turbine generators, the rotor of this machine is provided with only one bearing, the outer end of the rotor being supported by the inboard turbine bearing. The generator shaft is connected to the turbine shaft by a flange coupling. No bedplate is used under the generator or turbine, but the bearing pedestals, generator frame and turbine frame are grouted in on the foundation. The generator frame is provided with wide supporting flanges, which rest on the foundation. The end bells on each end are split in four parts to facilitate their removal. The outer end bells carry air from below the foundation into the entrance to the fan and are separate from the inner bells, which inclose the end windings. Each bell is split vertically on the center line of the shaft. The end bells rest on a casting that forms the lower half of the inner end bell compartment. This casting has a flange at both ends for grouting in on the foundation. This construction eliminates the expensive and heavy bedplate sometimes used with turbine generators.

The 12,500-kva. generator was installed during the early part of 1925 and has been in service since that time. In spite of the great length of rotor and its high rotative speed, the balance of the machine is as good as that obtained with any of the smaller 3,600-r.p.m. machines. The construction of a 12,500-kva. machine at 3,600-r.p.m. marks a considerable advance in the design of equipment for medium-sized power plants.

Testing Polarity of Transformers

By Edward Swan

DETERMINING the polarity of transformers before connecting them into a bank has much to recommend it, from the viewpoint of safety and economy. The test is easily made, and it eliminates guesswork in making the connections and may be the means of saving a large repair bill as well as eliminating the inconvenience of having the transformer out of service.

It is becoming general practice to mark the leads of

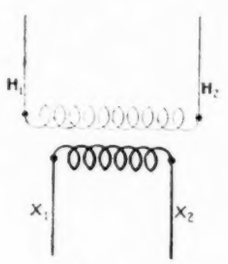


Fig. 1 — Lead marking for subtractive polarity

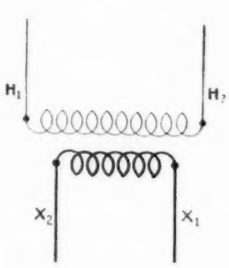


Fig. 2 — Lead marking for additive polarity

transformers according to their polarity. The standard marking recommended for single phase by the Electric Power Club is that shown in Figs. 1 and 2. These rules recommend that the numbering of the high-voltage and low-voltage leads be so applied that when H_1 and X_1 are connected together, as in Fig. 3, and voltage is applied to the transformer, the voltage between the highest numbered *H* lead and the highest numbered *X* lead shall be less than the voltage applied to the high-voltage winding. That is, in Fig. 3 the

voltage E_1 indicated by the voltmeter should be less than E, which is applied to the terminals H_1 and H_2. When the lead markings are as in Fig. 2, the test is made as in Fig. 4, and what has been said regarding Fig. 3 applies to Fig. 4.

The Power Club rules go on to state that when leads are marked in accordance with the foregoing rules the

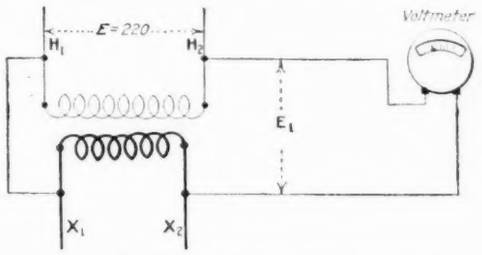


Fig. 3—Connections for checking subtractive polarity

polarity of the transformer is substractive when the H_1 and X_1 leads are adjacent as in Fig. 1 and additive when the H_1 is diagonally located with respect to X_1 as in Fig. 2. The rules define subtractive and additive polarity as: Imagine a single-phase transformer having

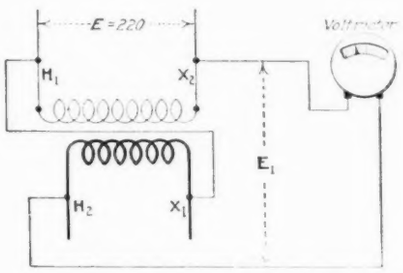


Fig. 4—Connections for checking additive polarity

two high-voltage and two low-voltage external terminals, as in Fig. 1. Connect one high-voltage terminal to the adjacent low-voltage terminal and apply voltage across the two high-voltage terminals, as in Fig. 3. Then if the voltage across the unconnected high-voltage and low-voltage terminals is less than the voltage applied across the high-voltage terminals, the polarity is subtractive; whereas if it is greater than the voltage applied across the high-voltage terminals, the polarity is additive. That is, with the connections as in Fig. 3, if the voltmeter reading is less than the voltage applied to the high-voltage leads H_1 and H_2, the polarity of the transformer is subtractive and if higher than the applied voltage, the polarity is additive. It might be added that the marking on the leads is such that when the current is flowing in on lead H_1 it is flowing out on X_1 if the leads have been properly marked.

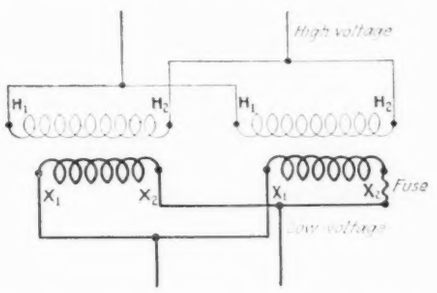


Fig. 5—Fuse wire connected into circuit to check parallel grouping of transformers

Instrument transformer leads are generally arranged for subtractive polarity as indicated in Fig. 1. The Electric Power Club recommends that the subtractive polarity shall be standard for all single-phase distribution transformers in size of 200 kva. and smaller, the high-voltage ratings of which are more than 7,500 volts; and additive polarity shall be standard for all single-phase distribution transformers in size of 200 kva. and smaller, the high-voltage ratings of which are 7,500 volts and below. For power transformers, subtractive

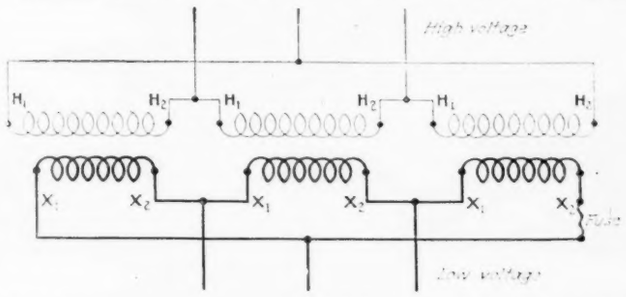
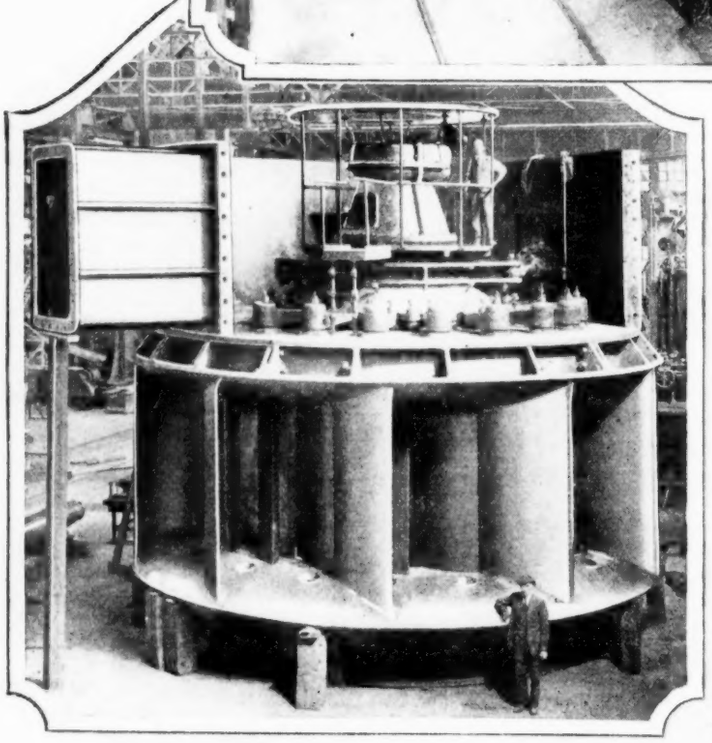


Fig. 6—Fuse wire connected into circuit to check delta grouping of transformers

polarity is recommended for all single-phase transformers in sizes above 200 kva., irrespective of voltage rating.

After a polarity test has been made on a transformer, if the leads are not already correctly marked, they should be marked to indicate their polarity so that the transformers may be placed in service at any time without doubt as to their polarity. Where a voltmeter is not available for testing the polarity of transformers and there is any doubt on the question, when the transformers are being grouped a piece of small fuse wire may be connected into the low-voltage grouping so that, if there is any cross-current flowing between the transformers, the fuse will be blown. Fig. 5 shows the location of the fuse on a parallel grouping and Fig. 6 for a delta connection. When the transformers are grouped and the fuse is connected in the low-voltage side, the primary switch is closed without load on the secondary. If the fuse does not blow, it is known that the connections are made correctly. The fuse wire should be of small capacity and of ample length to prevent the arc holding over in case the fuse blows.

THE SUCTION PIPE ON A PUMP should be large enough to keep the velocity of water down to about 230 ft. per minute. By the use of a smaller pipe requiring greater velocity there is too much loss of pressure in overcoming pipe friction. The higher the vacuum required at the pump the greater the amount of air liberated out of the water, giving trouble in operation of the pump. On the other hand, when a larger suction pipe is used, there may be less pipe friction from lower velocity, but more time is given for liberation of air from water that is subjected to less than atmospheric pressure. However, the pipe cannot be too large for those portions where the pressure in the suction pipe is above the pressure of the atmosphere.



Cedars Station on

IN THE 100 miles from Lake Ontario to Montreal, the St. Lawrence River falls 225 ft. and the average flow is about 230,000 cu.ft. per second. The possibilities of developing more than 4,000,000 hp. on this river and the proposal to improve the river so that ocean-going vessels may pass into the Great Lakes have attracted a great deal of attention to this waterway.

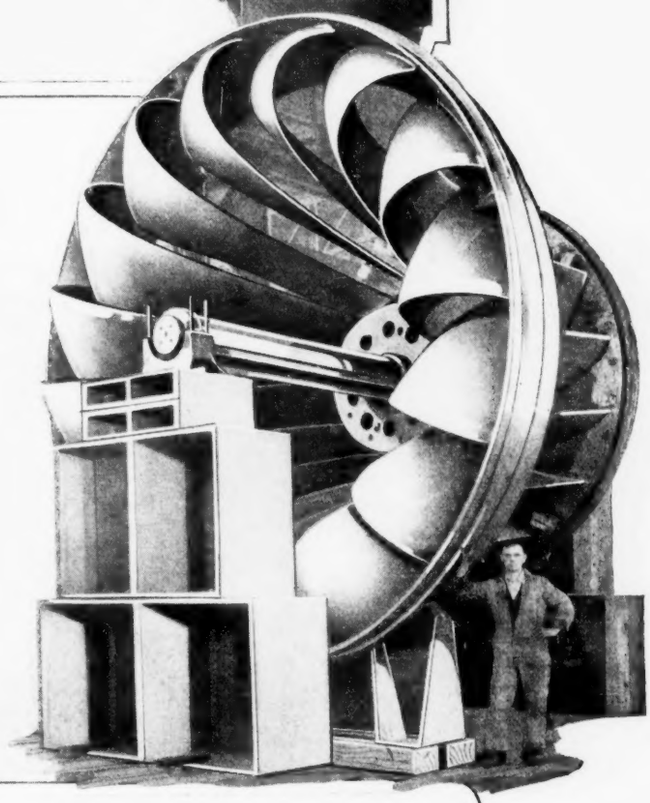
At the present time there are a number of power plants in the vicinity of Montreal that use part of the flow of the St. Lawrence River, but in no case does a dam extend all the way across the river. Of these, the Cedars Rapids plant of the Montreal Light, Heat & Power Consolidated is the largest. It was started in 1915, was completed last year and contains eighteen 11,000-hp. units operating under a

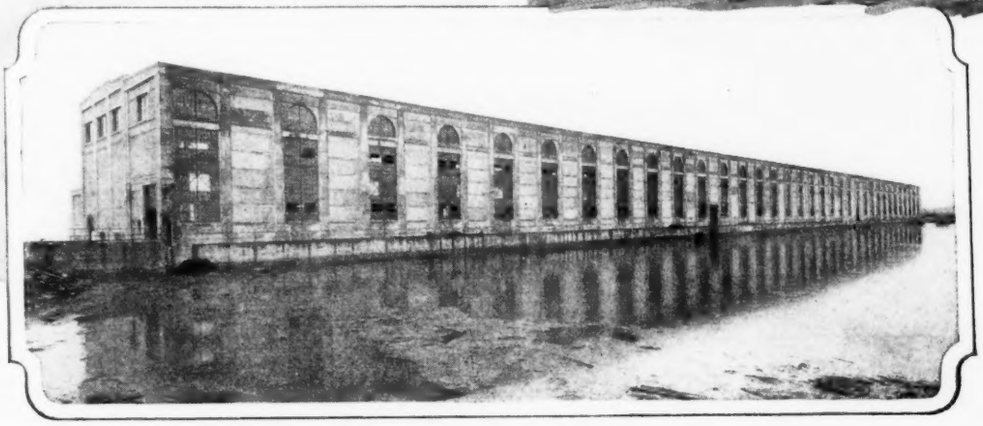
St. Lawrence River

32-ft. head at 55.6 r.p.m., and six 1,500-hp. exciter units.

The main generators, which are rated at 10,000 kva., are 32 ft. outside diameter, and the plant is 1,200 ft. long. The interior is shown in the upper left-hand and the switchboard in the upper right-hand photograph. On the left and right centers are shown the speed ring and runner for one of the turbines. The runner is 17 ft. 7½ in. in diameter and weighs 200,000 lb. At the lower left hand is shown an outside view of the down-stream side of the plant and in the lower right is a view of the up-stream side.

Photographs supplied by the Montreal Light, Heat & Power Consolidated and the Dominion Engineering Works.





Shipping Board Completes Tests on First of the Large Diesels on Order

Worthington Double-Acting Two-Stroke Cycle Diesel Developed Over 2,900 Hp. for 67 Days—Fuel Consumption 0.462 Lb. per Brake Horsepower-Hour, Using a Heavy Fuel Oil—Engine Started on 85-Lb. Air

ON MARCH 6 the Shipping Board inspectors finished the official tests on the first of the large Diesel engines contracted for by the board, this being a 2,900-hp. double-acting two-cycle engine designed and built by the Worthington Pump & Machinery Corporation. Dismantling of the engine is now in progress and it is expected that the Shipping Board will install the unit in the "Seminole."

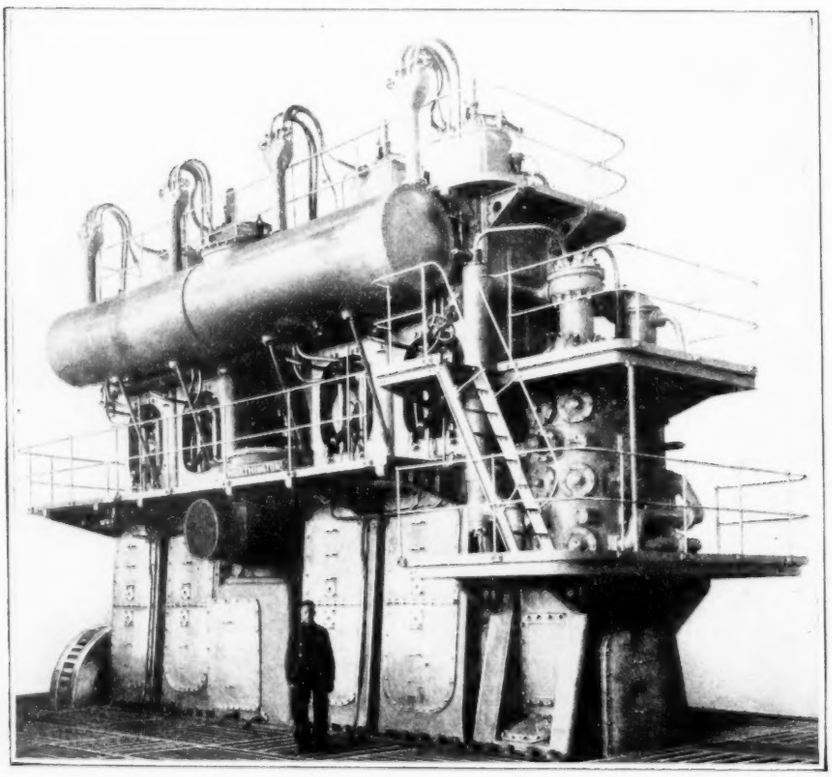
In embarking upon the extensive plans of changing steam-propelled cargo vessels to Diesel drive the board determined that inasmuch as this step was considered a radical one by many in marine circles, each contract for engines should embrace every feature that would guarantee that the units after entering into active maritime duty would prove economical in both fuel and lubricating oil consumption and at the same time so reliable that maintenance would be reduced to a minimum.

In accordance with this desire to safeguard public funds the board required that the engines undergo the following tests:

1. A 30-day continuous run at full load of 2,900 hp. at 95 r.p.m., subject to a tolerance of 1 per cent on power and an overload variation of 3 r.p.m.
2. A six-hour run at 10 per cent overload at 95 r.p.m.
3. A run of four hours with an increase of 10 per cent in the mean effective pressures and with 5 per cent increase in speed.
4. A six-hour run at three-quarters load.
5. Four hours' operating at one-half load.
6. Two hours at one-quarter load.
7. One hour at full load astern.
8. One hour of maneuvering tests.

The Worthington Diesel is a four-cylinder unit, the cylinder bore being 28 in., with a piston stroke of 40 in., and is shown in the illustration. The outstanding feature is the use of two steel, dome-shaped forgings that go to make up the two ends of each cylinder. Into these steel shells are placed thin cast-iron liners to take the wear due to the piston contact. This four-cylinder unit is a development of the single-cylinder engine completed about two years ago.

After the first of the engines ordered by the Shipping Board had been completed and erected on the test floor at the Buffalo works, arrangements were made to put it through the rigorous tests required by the terms of the contract. To provide a load, a 25-cycle, three-phase alternating-current generator was coupled to the engine shaft and the 30-day continuous run started on Feb. 2. This test was finished on March 4, and without adjustment or examination of any of the parts, the 10 per cent overload was immediately thrown on. Upon the completion of this six-hour run, the engine was successively submitted to the other tests listed. The total period required for these runs was slightly more than 31 days of continuous operation. The data covering the 30-day run at full load appear in Table I. The engine was shut down at 5 p.m. on March 5 and left under observation but without adjustment or examination of any kind until 9:30 a.m., March 6, at which time the maneuvering tests were begun. Although the machine had stood idle for sixteen hours in the cold building, as soon as the control lever was set to the starting position the engine began firing at the first revolution, even though the fuel pumps had



Worthington 2,900-hp. Diesel tested by the Shipping Board

not been primed. The maneuvering tests, which by contract were to be for one hour only, were continued for several hours. These tests, in conjunction with the preliminary shop tests, made a total of 67 days of continuous operation.

Since maneuvering ability is a prime requirement in a marine engine, the results of these tests are of more than passing moment. It was found that the time required for reversal averaged 8.55 seconds, with a minimum of but 4.8 seconds. This time is that elapsing from the moment when, with the engine at full speed in one direction, the starting lever was thrown to reverse, until combustion ensued with the engine rotating in the opposite direction. This rapidity of reversal was not due to any unusual skill of the test engineer, for the operations were performed by a number of the observers, many of whom had had no previous experience with Diesel engines. During the maneuvering twenty-three reversals were obtained with a starting tank capacity of 855 cu.ft., the pressure gradually dropping from 337 to 195 lb. Additional reversals were made until the pressure dropped to 85 lb., the total number of reversals being forty-two. This was equivalent to the use of 350 cu.ft. of free air per reversal, less than one-half the guarantee figure.

Fuel Consumption

It will be seen from Table I that the average fuel consumption for the 30-day run was 0.462 lb. per brake horsepower-hour. This was obtained with fuel oil having the following general characteristics of the Bunker "B" specifications:

Gravity, Baumé, at 60 deg. F	20.19
Flash point, deg. F	177
Burning point, deg. F	270
Viscosity, Saybolt, at 122 deg. F	181
Hydrogen, per cent	13.02
Oxygen, per cent	0.37
Carbon, per cent	85.29
Water, per cent	0.11
Asphalt, hard, per cent	5.95
Sulphur, per cent	0.37
Ash, per cent	0.08
Heat value, B.t.u. per lb	18,733

However, the fuel received showed some variations; some was decidedly inferior, being as low as 14 deg. Baumé. The oil was not centrifuged and as a result grit was constantly working through the fuel pump and spray valves, although no ill effects resulted. The value given for the fuel consumption is subject to a correction which, it is estimated, will bring it down to approximately 0.44 lb. per b.hp.-hr. The generator was rated at 1,400 kw. and the efficiency used in determining the load on the engine was 95.1, exclusive of the excitation, this being that determined by an A.I.E.E. code test conducted by the electrical builder. However, there is no doubt that at the load carried, 2,900 hp., the generator efficiency is lower than at full load, and if so, the actual engine load was higher than computed and the fuel consumption lower. Upon testing the second of the Shipping Board engines, the Worthington engineers will make an actual input-output test of the generator in order to arrive at the true engine performance. It is probable that the engine in its overload test actually exceeded a load of 3,500 hp. and that the fuel consumption at full load was not more than 0.44 lb. per brake horsepower.

Since the engine was engaged in a long-run test, no special pains were taken to reduce the lubricating oil consumption to a minimum. Still, as shown by Table I, the brake horsepower-hours per gallon of lubricating oil were 4,104.

TABLE I—30-DAY TEST ON WORTHINGTON TWO-CYCLE, DOUBLE-ACTING DIESEL

Date of test	Feb. 2 to March 4, 1926
Location	Buffalo, N. Y.
Builder	Worthington Pump & Mach. Corp.
Test conducted by	U. S. Shipping Board
Duration of test, hours	720
Revolutions per minute, average	96.4
Total r.p.m.	4,164,952
Brake horsepower, average	2,907
Indicated horsepower, top of cylinder	558
Mean indicated pressure, lb. per sq.in.	93.2
Indicated horsepower, bottom of cylinder	450
Mean indicated pressure, lb. per sq.in.	83.7
Indicated horsepower, total	4,035
Mean indicated pressure, average	88.5
Mechanical efficiency, per cent	72.7
Air compressor indicated horsepower	187.8
Scavenging pump indicated horsepower	194
Fuel per i.hp.-hr., lb.	0.332
Fuel per b.hp.-hr., lb.	0.462
Thermal efficiency, per cent	29.6
Lubricating oil, gal. per 24 hours:	
Power cylinders	2.79
Stuffing boxes	4.25
Air compressor	0.46
Scavenging pump	0.17
Hand feeds	0.26
Crank case	7.07
Total, gal. per day	15.00
Cooling water, gal. per b.hp.-hr.	5.5
Temperatures:	
Cooling water, deg. F. to compressor	35
from compressor	40
Cooling water, deg. F. to jackets	40
from jackets	120
Cooling water, deg. F. to pistons	40
from pistons	105
Exhaust temperature, deg. F.	532
Lubricating oil, deg. F., to engine	95
from engine	96
Fuel oil, deg. F.	89
Engine room, deg. F.	68
Outside air, deg. F.	29
Compressor air temperatures:	
1 stage, deg. F. to cooler	142
from cooler	43
2 stage, deg. F. to cooler	139
from cooler	43
3 stage, deg. F. to cooler	138
from cooler	42
4 stage, deg. F. to cooler	234
from cooler	77
Pressures:	
Injection air, lb. per sq.in.	890
Standby air receiver, lb. per sq.in.	869
3 stage of compressor, lb. per sq.in.	246
2 stage of compressor, lb. per sq.in.	74
1 stage of compressor, lb. per sq.in.	24
Scavening air, lb. per sq.in.	11½
Lubricating oil, lb. per sq.in.	12
Cooling water, lb. per sq.in.	30
Barometer, in.	29.09

Interest, of course, was displayed in the probable cylinder wear. After the completion of the tests the top cylinders and pistons were removed to permit examination of liners, pistons, rings, stuffing boxes, etc. It was found that in a total of 67 days of operation, the wear in the liners averaged 0.002 in. There was no evidence of scoring in any of the liners or pistons, the surfaces having a fine glaze. Every piston ring was free in its groove and gumming was entirely absent.

No Trouble with Stuffing Boxes

Much discussion has been centered on the question of stuffing boxes of double-acting engines. The stuffing boxes of this engine are provided with metallic packing rings, and no evidence of wear or overheating was present. The piston end is water cooled and the packing rings are exposed to no high temperatures.

In fact, by reason of the design of the piston and lower head, the stuffing-box rings are never in contact with any part of the rod previously exposed to the flames of combustion. From all appearances, the doubt often expressed as to the trouble to be expected with rod stuffing boxes can now be set at rest.

The wear on the running gear, including main journals and crankpins, was not ascertained, although inspection revealed that the wear was insignificant.

Automatic Refrigerating Plant in the Henry Grady Hotel

The Henry Grady Hotel, Atlanta, Ga., which was completed last year, is supplied with refrigeration, ice and ice water by an automatic 12-ton ice machine. This machine starts, stops and functions without manual control, thermostats operating the motors driving the compressor and brine pump.

SOUTHERN HOTELS do not require the large amount of steam heating used in the North, and as a consequence few have generating units; low-pressure boilers are in general use and electric power is purchased. The refrigerating service supplied in a

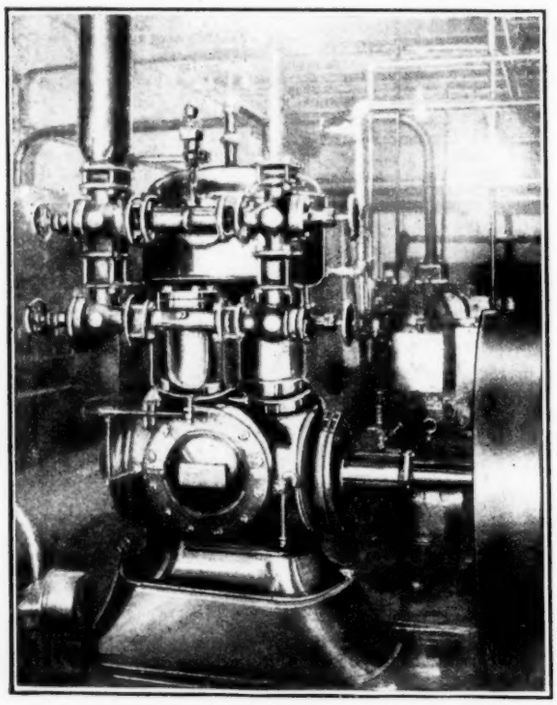


Fig. 1—Frick automatically controlled compressor

hotel is far more variable than that in a commercial ice plant, inasmuch as cold-storage doors are being constantly opened and closed in the removal of food. A machine must be large enough to remove the heat brought in by fresh food supplies without delay, yet it must be capable of being operated at a low capacity during the non-rush hours. Some form of regulation is a necessity, and if this be hand control, there must be an attendant to give constant attention to the refrigerating machinery. In a small plant the wages of such help is a serious item, based on the cost per ton of refrigeration, and as they are not always busy, the temptation to use the operators for other odd jobs is always present. This naturally leads to trouble with the refrigerating plant.

The small household automatic refrigerating plant has become thoroughly standardized and has been developed to a point where it functions reliably. Larger

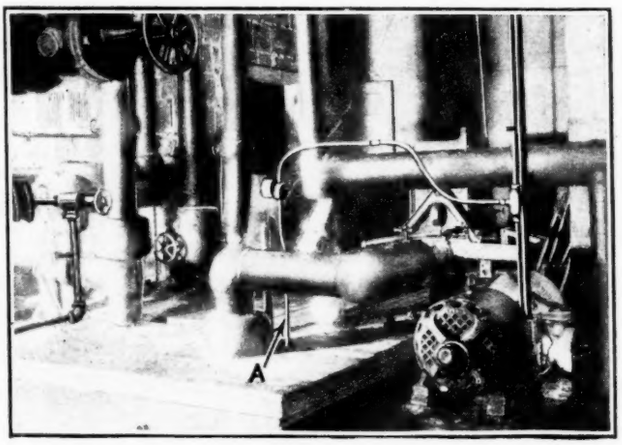


Fig. 2—Brine pump and thermostat

machines, however, offer peculiar problems not encountered in the miniature units.

The motor must be self-starting, calling, in sizes of 25 to 75 hp., for a special motor that can be cut onto the electric circuit without undue disturbance to the rest of the hotel electrical equipment. The entire

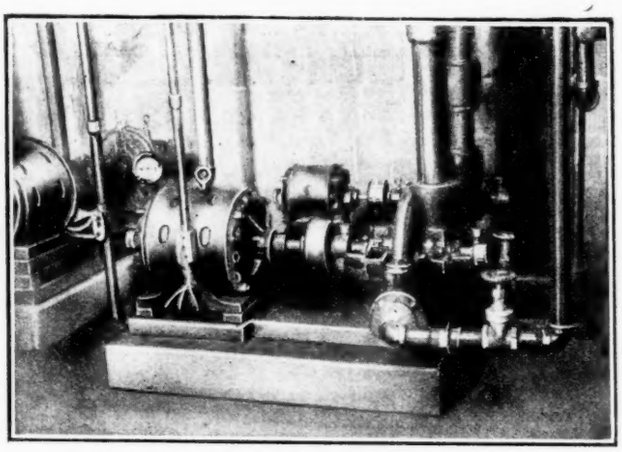


Fig. 3—Ice-water circulating pump

installation must be interconnected so that the compressor cannot operate when the brine motor is idle, for if this were not taken care of, the brine tank would freeze, due to low suction pressures and temperatures. A number of the refrigerating machine companies have developed more or less satisfactory automatic plants; few however, are of the capacity of the Grady plant.

The refrigerating plant is located in the sub-basement below the kitchen of the hotel. An 8x8-in. twin-cylinder vertical inclosed compressor, shown in Fig. 1, is belt driven by a 40-hp. automatic starting motor. The ice-freezing tank holds twenty 100-lb. cans, freezing about one ton of ice a day. As a hotel must have crystal clear ice, a low-pressure raw-water system was installed. The air for agitation is obtained from a 1½-in. blower driven by a 1-hp., 1,725-r.p.m. motor. The cores are drawn by a 1½-in. centrifugal pump, direct connected to a 1-hp. motor. This tank is located back of the compressor with its top a few inches above the floor level.

In the end of the tank nearest to the compressor is a shell-and-tube brine cooler submerged in the brine tank. A 2-in. centrifugal pump, direct connected to a 7½-hp., 1,725-r.p.m. motor, shown in Fig. 2, draws the cold brine from the cooler and pumps it through the coils in the kitchen cold-storage rooms. In the return from each one of these storage compartments there is a thermostatically regulated valve, with the thermostat tip resting inside the storage room. These valves control the temperatures by regulating the brine flow, and each can be set to give any desired storage temperature.

Another important feature in this installation is the drinking water system. The water is taken from the city line and a 1½-in. centrifugal pump direct connected

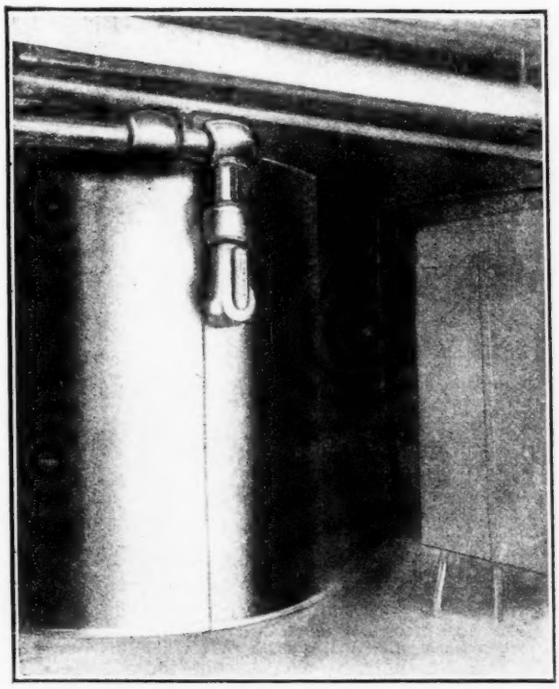


Fig. 4—Drinking water cooler

to a 7½-hp., 1,725-r.p.m. motor, shown in Fig. 3, forces the water through the galvanized cooling tank, Fig. 4, and into the house drinking water system. This tank is insulated with cork and contains a set of brine coils. A thermostatically operated valve on the brine return line controls the ice water temperature. To insure water in case trouble occurs with the tank or circulating pumps, a second pump is installed as a stand-by.

The double-pipe condensers are mounted on the machine room wall. Water is taken from the city line and put through the coils by a 1½-in. centrifugal pump direct connected with 7½-hp., 1,725-r.p.m. motor.

The thermostat that controls the operation of the compressor is placed in the brine tank, being shown at *A* in Fig. 2. This acts on a control switch to start the compressor motor when the brine temperature drops

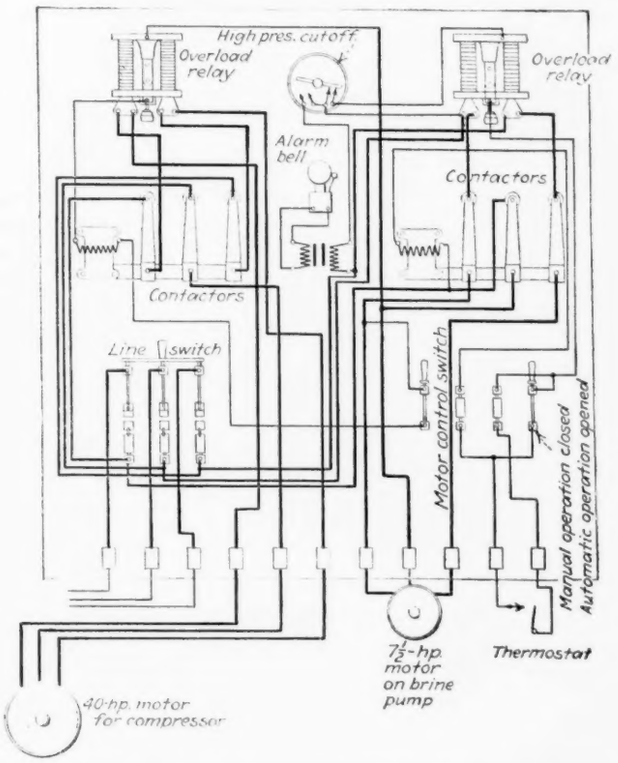


Fig. 5—Wiring diagram for Frick automatic system

below a predetermined point. The brine pump motor circuit is connected so that the compressor motor cannot start if current is not being supplied to the brine pump motor. This prevents a freeze-up of the brine tank and trouble with the tubes of the brine cooler. In Fig. 5 is shown the electrical wiring diagram and the interlocking arrangement.

THE PROBLEM OF ACCIDENT PREVENTION, stripped of all trimmings, comes down to a very simple formula. Make it some person's business to discover unsafe conditions and practices and then do what is possible to eliminate them through active co-operation between this person and those responsible for the performance of the workers. Education of the workers is obviously required, but discipline to enforce the results of education is equally essential.—*C. F. Hirshfeld in the N.F.L.A. Bulletin.*

A WELL-LUBRICATED JOURNAL BEARING moves about as easily as a good ball or roller bearing, once it is started, so that an oil film is established. The ball or roller bearing has the advantage of easy starting, but its principal advantage is in its smaller clearance and reduced oil consumption and bearing wear. These features are of great value in certain gear applications where center distances must be set accurately, and in places where the bearings are not readily accessible.

Causes and Suggested Cures for Low Power Factor

By Egbert Douglas*

LOW POWER FACTOR has become a chronic disease of the alternating-current distributing system, and this has inflicted the isolated plant as well as the central-station systems with numerous troubles. Much of this low power factor has been caused by haphazard over-motoring. In fact, in the isolated plants it is due almost entirely to this one cause. But in the central-station systems underloaded transformers contribute a very substantial amount of wattless current toward this malady. As a means of distributing electrical power the three-phase alternating-current system will probably be the dominating system for many years, and the squirrel-cage induction motor will by far outnumber all other motors in general use on account of its extreme simplicity and low first cost and maintenance.

The squirrel-cage induction motor is almost as simple as an old-fashioned grindstone and is just about as simple to operate. This simplicity and low cost have helped toward its contributng much more than necessary to the low power factor malady. Induction motors of the squirrel-cage type are cheap, but they have very decided characteristics that cause many wrong applications that lead directly into paths of low power factor.

Starting and Speed Characteristics

The squirrel-cage induction motor during starting comes up to speed rapidly, and when driving loads of considerable inertia it often results in motors of much larger capacity being used than is necessary. This is on account of the excess load thereon due to the rapid acceleration inherent in this type of motor. It frequently happens that the peak load on a motor is found only when it is started, and this peak is caused by rapid acceleration of the load. The trouble here is not infrequently not one of torque but one of acceleration. In other words, acceleration and torque have been confused, and the effort to get a motor large enough to accelerate high-inertia loads rapidly has often resulted in greatly oversized and consequently underloaded motors, much of the time with attendant low power factors.

Much could be done in the direction of bettering power factors in cases of this kind by substituting wound-rotor motors for machines of the squirrel-cage type. Starting conditions could then be controlled, and consequently smaller and more fully loaded motors could be used and better power factor would naturally be the result.

The Disease of Individual Motors

There has been a strong tendency during the last few years toward putting an individual motor on each machine and several motors on some machines. This automatically leads to lower power factors, because when a motor is applied to an individual machine the motor must be large enough to meet the extreme condition under which it may be called upon to operate. The woodworking industry is now contributing a large share of low power factor germs due to these features. Many direct-connected motors now built as integral parts of machines are greatly underloaded because they are operating in factories where the work is much lighter than the maximum conditions for which the machines are designed.

Low-speed motors are the cause of much of the low power factor trouble, because at light loads their power factor is much lower than that of the high-speed motor. This particular feature does not seem to be very well understood by the rank and file of motor users. The motor user often thinks that a motor running at, say, 600 r.p.m. will outlast by many years a motor running at 1,800 r.p.m., and he therefore is willing to pay the increased cost of the low-speed machine and adds to the low power factor troubles. He little dreams that many of the generators that supply power to his motors run year in and year out at 1,800 r.p.m., and many of them at double this speed.

Fallacy of Low-Speed Motors

The fallacy of the low-speed motor from a power-factor viewpoint is best brought out by a comparison of motors of a given size and at different speeds. The figures given in the accompanying table are fairly representative of present-day conditions:

Comparison of High-Speed and Low-Speed Squirrel-Cage Motors

Size, Hp.	Speed, R.p.m.	Power Factor ½ Load	Power Factor ¾ Load	Power Factor Full Load	Approx. Weight	Approximate Cost Total	Approximate Cost Cents Per Lb.
10	1,800	81	88	90.5	300	$125	40
10	600	58	71	79	840	285	34
15	1,800	82	89	92	425	155	36
15	600	67	77	83	925	340	36
25	1,800	82	89.5	93	570	215	37
25	600	65	76	81	2,330	470	20
30	1,800	83	90	93	600	250	40
30	600	65	76	80.5	2,350	490	20
40	1,800	85	90	92.5	925	310	33
40	600	66	78	82.5	2,375	575	24
50	1,800	79	87	90	1,035	370	35
50	600	66	78	82.5	2,500	650	26

From these figures it will be noted that the price does not go up for the larger motors nearly as fast as the horsepower of motor rating. For example, a 15-hp. motor at 600 r.p.m. costs about $340 and a 30-hp. motor —one double the size—costs $490, or only 44 per cent more. Most users of power naturally have visions of growth in mind and wish to plan a little into the future, and additional capacity costs so little. The thing from a low power-factor viewpoint easily becomes badly overdone.

It will be noted from these figures that the low-speed motors when partly loaded have a very low power factor. Take, for example, a 10-hp., 1,800-r.p.m. motor. It has a power factor at one-half load of 81 per cent and at full load 90.5 per cent, or a difference of 9.5 per cent between half and full load. But with a motor of the same size running at 600 r.p.m., at half load the power factor is 58 per cent and at full load 79 per cent, or a difference of 21 per cent. At full load the 1,800-r.p.m. motor has a power factor 11 per cent better than the 600-r.p.m. machine.

Many motor installations are laid out by motor salesmen or representatives of jobbers selling motors and other equipment incident thereto. These motors are sized in hundreds of cases on pure guesswork, and no good salesman will take chances on guessing too close. One of the worst examples of poor power factor that has come to the writer's attention was in a large woodworking plant where an installation of several hundred horsepower was laid out by the sales force of a large electrical manufacturing concern. Its equipment in both motors and generators was installed. This was the

*Cahill & Douglas, Consulting Engineers, Milwaukee, Wisc.

only obligation on the part of the purchaser for his free engineering service. When the plant was started the power factor was about 50 per cent and the lagging current was so great that the generators could not carry the load. The manufacturing concern then promptly cured the trouble by selling the customer a synchronous condenser large enough to bring the power factor up to 90 per cent. This may be good salesmanship, but the same cannot be said for the engineering.

Danger of Motor Oversizing

Again, frequently manufacturers of machinery that motors are to drive are at fault as to motor oversizing. A case in point once came to my attention while changing over a woodworking plant from mechanical to electrical drive. There were two machines on which there was little or no information as to power requirements. The owners and the manufacturers of these machines were asked how much power they took. They agreed that about 75 hp. was a fair figure. The belts on these machines at their speeds and contact surfaces indicated that 75 hp. was an impossible figure. A guess of 35 hp. was made, because the load could not be measured at the time. A 35-hp. motor was installed, much against the manufacturer's wishes, and then a test was made that showed 17 hp. to be the maximum load. The motors were then changed to 15 hp., or just one-fifth of the manufacturer's recommendations.

There is probably no line of engineering work today where more guesswork is used than in selecting motors. Among the motor salesmen, the power salesmen, the wiring contractors, the insurance inspectors and the purchasing agents the power-factor situation has been pretty badly mussed up. It apparently does not get any better, and until more real honest-to-goodness engineering is put into this work it probably will not get better.

The power companies have been passing their low power-factor troubles along to the customers by setting up penalty clauses in their rates or offering lower rates as an incentive for the power user to correct his power factor. The central-station company's interest ceases when the power factor is bettered. Many of the cures could be greatly improved upon and at much less expense from the power-user's viewpoint if the motors themselves were looked into more carefully when they are purchased and installed.

Bad Pulley and Belting Conditions

Many machines are built where pulley sizes and belt speeds are very bad and in many cases low-speed motors are installed purely on this account. A case recently came to the writer's attention where an exhaust fan was installed requiring 60 hp. The fan was so designed that the rim speed of the fan pulley was only about 2,000 ft. per minute. The fan was so designed that a larger pulley could not be applied to it until the bracket supporting the outboard bearing was redesigned. A 600-r.p.m. motor was necessary as the fan was originally built, but by changing the bracket design on the fan to accommodate a larger pulley, increasing the belt speed to 4,500 ft. per minute, which is good practice, an 1,800-r.p.m. motor was used.

It cost $75 to change the fan bracket, and this change saved about $300 in the cost of the motor to drive it. The power factor of the motor was increased from 66 to 80 per cent at the same time. A much smaller belt was used due to the higher speed and the job generally was much improved.

The power-factor problem needs more attention at the source of the ailment and fewer corrective remedies applied to undo things that are obviously wrong at the outset.

Machine Shop Equipment for the Power Plant

By G. Grow

IN ANY power plant there is a more or less amount of machine-tool and machinist work to be done, and the question arises, Should the plant install a machine shop of its own?

A small plant must necessarily call in the services of an outside machine shop, for the total amount of this work would not justify the installation of many machine tools. There is, however, a plant capacity, or, at least, a total plant-repair outlay above which the investment in machine tools is fully justified. Just what this plant capacity is depends upon operating conditions, age of machinery and other factors. A plant of 3,000-kw. capacity certainly should have a repair shop and many of one-half this size would find the capital outlay on machine tools paying large returns.

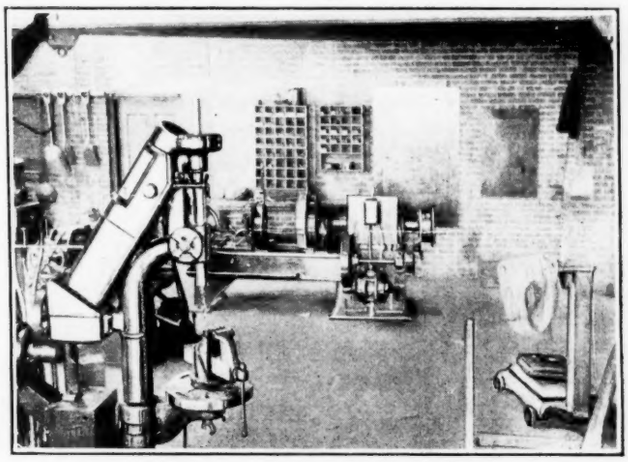


Fig. 1—The drill press is used almost daily

Just what tools should be installed is a debatable question. In all events, the lathe is a prime requisite, and this should be large enough to accommodate any work that might require turning. A swing of 16 in. is not too large to take care of small work and is large enough to handle almost any pipe flange and almost any other part needing to be machined. Since shafting for centrifugal pumps, steam engines, stoker drive and so forth must be accommodated, a lathe bed of at least 16 ft. should be insisted upon, one of 20 ft. being still better. Inasmuch as the price of the machine is dictated more by the swing than by the bed length, a few extra feet of bed will not cost heavily and may some day be needed, especially in the case of threading pipe of too large diameter to be handled by the pipe machine.

A radial drill or drill press is a necessity in any plant. This should have a 24-in. arm or table at the minimum to accommodate the large drilling work.

A small milling machine, or, if this be considered too

costly, a shaper will handle much of the work usually sent outside. Of the two, the milling machine is the superior, since it will handle work impossible to be done on the shaper. If a dividing head be added, it is no great trouble to cut gears needed on a hurry-up job, although as a rule it pays to procure new gears from the original maker.

A power hacksaw is another adjunct that should be installed in the up-to-date plant shop. There are hundreds of uses for it, from cutting bar stock for the blacksmith to drill rod needed by the machinists for valve spindles.

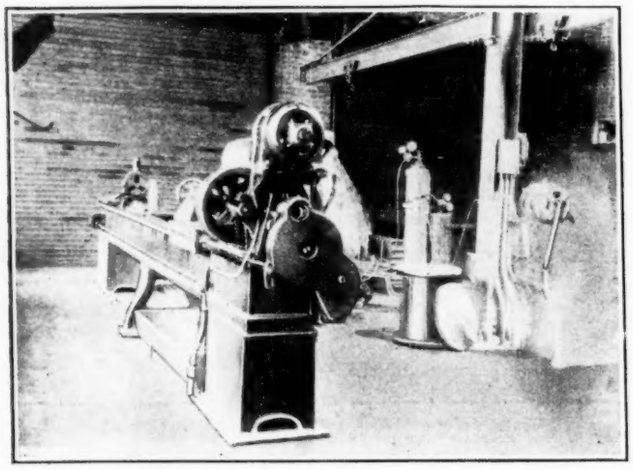


Fig. 2—A long bed lathe is used for general work

Of course a pipe machine is among the tools of even the most meagerly equipped shop. Probably more pipe work is done in a power plant than all other kinds of repair work. Although it is possible to hand cut and thread pipe of 1½- and even 2-in. diameter, it is slow, laborious work, and a pipe machine is to be preferred even for such sizes. How large a pipe the machine is to handle depends upon the plant; at all events it should accommodate pipe up to 6 in., above which the lathe can be called into play.

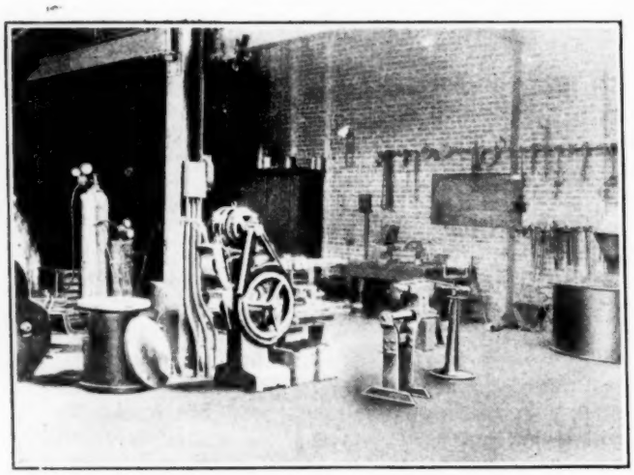


Fig. 3—The power hack saw, with the forge and blacksmithy equipment at the left

Some sort of power-driven emery wheel is found in most plants. If line shaft is available, a belted wheel is satisfactory, although a combined motor and wheel makes the neater and safer installation. A grindstone, being a slow-moving machine, may well be belted to a motor or line shaft. For sharpening tools it is far better than the emery wheel.

An electric drill, even though no other machine tool is in the plant, is now almost a necessity. This should be of the two-speed type to take care of fast and slow drilling.

Any machinist can do a certain amount of blacksmithing, and a forge, anvil and tools should be purchased. Many who are skilled at the machinist trade object to forged work, but this seldom applies in a plant where there is not enough work of this kind to keep a man busy.

The municipal power plant at Jacksonville, Fla., has a well-equipped machine shop. The plant has an installed capacity of 27,500 kw. but the average load is approximately 12,000. One machinist or repair man is kept on the payroll and does all the repairing in the plant, including the boiler work. The machine shop is an annex just off the boiler room and contains the following list of machine tools:

1 Lathe, 18-in. swing by 16-ft. bed, geared to 3-hp. 1,250-r.p.m. motor.
1 24-in. drillpress, geared to 5-hp. 1,150-r.p.m. motor.
1 6-in. pipe machine.
1 Pipe and bolt machine, geared to 3-hp. 1,730-r.p.m. motor.
1 14-in. power hack saw, belted to ½-kw., 550/850 variable-speed motor.
1 Electric energy wheel.
1 Forge.
1 Grindstone, belted.
1 Jeweler or model lathe.
1 Hand electric drill.

Some of these machines are shown in the illustrations. The equipment listed may appear too complete and expensive for most plants; however, they have paid for themselves many times over.

Here's a Real Plant for You

An electric power plant with a capacity of only four flatirons was a discovery announced yesterday by the publicity department of the General Electric Co. The plant is in the village of Wales, N. D. Its officials recently announced to the eight owners of electric irons in the village that four of them would have to do their ironing in the morning and four in the afternoon. After naming the flatiron customers and their times for drawing on current, the announcement said:

"If any others want to use power at these times, they will have to see the engineer. It is for your own good to observe these rules. If more go on than the plant will handle you do not get the power you want, and besides you hurt the engine by overloading. Further, if these rules will not be obeyed, there will have to be only one time set for ironing or we will run the big engine."—*New York Times.*

THE SIZE OF OVERFLOW AND VENT PIPES on boiler-blowoff tanks is regulated by law in certain localities. A rule for the size of these pipes that will conform with practically all these laws as well as being generally applicable is to make the area of the overflow pipe and also the area of the vent pipe equal to at least three times the area of the boiler-blowoff line. For example, if the boiler-blowoff line were 4 in., its cross-sectional area would be 12.562 sq.in. Three times this area would be 37.68 sq.in., and the nearest commercial size of pipe having an equal or larger area would be 7 in.

What Makes a Plant Economical?

IT HAS become common to hear reports of boiler efficiencies of the order of 80, 85 or even 90 per cent for monthly average operating results. Most of these reports emanate from large power plant boiler rooms and the small plant engineer is prone to dismiss them with the thought that such results are easy of attainment under the rather Utopian conditions commonly supposed to prevail in central stations.

Although there are undeniable points of physical superiority in some large plants, it is nevertheless true that many of the alleged advantages are purely illusory. It is true that larger boilers tend to slightly better performance than small ones, but the difference is not great. Base-load operation is a phrase that has been used much of late, but it occupies a larger place in the literature than it does in actual operating experience. The plant is rare indeed which operates day and night at constant load.

There is one respect in which the central station has a distinct advantage. The diversity of customer demand tends to develop load curves of reasonably constant shape for each day of the week. This gives the central-station operator the advantage of knowing when a load change is likely to come and about how much it will amount to. In addition to this information, he has learned what to expect from cloudy or rainy weather, thunderstorms and the like. This information is invaluable in the management of a boiler plant. However, such knowledge need not be and should not be confined to the large plant. Why cannot the engineer of an industrial plant maintain a record of load embodied in a daily load curve? In many such plants there is at least the possibility that the aggregate load may display a surprising degree of regularity from week to week. Further, co-operation between the power plant operators and the men in charge of factory processes utilizing power or heat may develop into an agreement whereby large demands will be announced to the power plant in advance, perhaps by a simple push-button signal.

Moreover, the importance of load variations has been somewhat exaggerated. Of course it is pleasant to operate a boiler with constant load, but it is most unusual even in a large plant. Fluctuations are sometimes annoying, but they frequently produce more trouble by way of smoking than they do by way of reduced efficiency.

None of these "alibis" explain the superiority of the large central-station boiler room. The real reason that performance is better in such plants is that more intelligence is applied to the task. Instruments are of course provided, but the important thing is that they are used regularly, systematically and consistently. The load is studied, and its characteristics are well known. The equipment is known in every detail and its possibilities are developed to the utmost. The engineer in charge of the station gives much attention and careful thought to boiler-room operation, and his immediate assistants in charge of the boiler room spend much time in informal but effective efforts to educate each member of the crew to an intelligent understanding of the processes under his control. Results are watched in detail, and any shortcomings are immediately discussed with the men responsible for them.

Boiler-room performance depends almost entirely upon the operator. The condition of the equipment is certainly his responsibility. The intelligent operation of that equipment rests with him. If instruments are provided, his is the duty of using them. If the boiler room is not equipped with every instrument devised by the genius of man, it is nevertheless possible to operate it intelligently. In fact, it is surprising what good results an experienced and conscientious operator can secure under the guidance of a few instruments. Naturally, an experienced operator finds an important criterion in the appearance of the fire.

The economy of a boiler room depends upon the men who operate it. If they wish to secure economy, they can do so. Of course, there are physical limitations that no intelligence and skill can eliminate. On the other hand, it is the duty of every power-plant operator to secure from his equipment the utmost of which it is capable. Only when he has done this can he go to his employer with a clear conscience to request money to be spent for new equipment.

Histories of American Engineering

AMERICAN ENGINEERS are so interested in the big things now being done and the attempts to accomplish still greater things that the history of past development is being overlooked. The men who have lived through some of the developments that are at the foundation of our present engineering are dying one by one, and the story of many interesting facts and incidents connected with this early work will pass with these pioneers. In other countries more attention is given to the history of industrial developments and records are preserved.

Some of our former leaders in engineering have had their life work recorded in biographies. Among these are those published by the American Society of Mechanical Engineers covering the lives of Fritz, Westinghouse, Taylor, Sweet and Brashear. It is hoped that these may be followed by other volumes of the lives of other engineers. Such life stories are of great interest, but are naturally centered around the one personality that is the subject of the particular volume.

Stories of developments that were the work of many engineers would make interesting reading. For instance, an intimate story of the early history of the development of certain well-known steam turbines or boilers, with an account of the parts played by the various engineers, would prove of interest to all power

engineers. The authors of such stories should get the personal touch and give credit to those to whom credit is due.

There are other classes of machinery about which fascinating stories could be written. Such stories would relieve our engineering journals of their strictly technical details, for who does not like to read a well-told tale? They would also prove a source of great inspiration to our younger engineers, for they could see how men in large and small organizations can, by using their joint abilities, contribute their share to the development and improvement of modern equipment. Stories of men and of developments are surely worth putting on record.

Desirable but Doubtful

A STANDARD by which the performance of different designs of a device may be compared is a desirable feature in any branch of engineering. Unfortunately such standards of comparison are not always easily established, or readily agreed upon by those who are to make use of them. At the present time attention is directed toward setting up some basis of comparison by which draft-tube experiments made in various laboratories can be compared. This is a worthy undertaking, and a valuable addition to the art of draft-tube design would result from the establishing of some such standard.

In the operation of any piece of power machinery it is important to know the input and output, as from these the over-all efficiency can be obtained. Although the over-all efficiency can in general be ascertained with fair accuracy, is may be difficult to arrive at the efficiency of the component parts making up the equipment. A boiler equipment may be considered as consisting of the boiler proper, furnace, fuel- and air-feeding equipment and the draft equipment. It is a comparatively easy procedure to determine the over-all efficiency of the boiler plant, but just what each of the parts making up the equipment contributes to the final results would be difficult to decide. Furthermore, it would be a difficult matter to establish a standard whereby the performance of any part of this equipment under one set of conditions could be compared with a similar part operated under a different set of conditions. It would be desirable if this could be done, but the chief thing that interests the power plant operator is that a combination of steam-producing equipment is obtained that gives a high efficiency consistent with other conditions.

In dealing with hydraulic turbines an analogous condition exists. The hydraulic installation consists of the turbine proper, an open flume or scroll case, and a draft tube. The designer's problem is to work out a combination of these parts that will give the highest efficiency consistent with other conditions. It is generally recognized today that the turbine setting and draft tube cannot be designed separately from the turbine and obtain the best results. Best operation is obtained only when all three parts are designed as a unit.

A draft tube that may be suited to one set of conditions may be unsuited for another set. The function of a draft tube also varies with the type of installation. On a high-head project the efficiency of the tube is of small consequence compared with maintaining hydraulic conditions that are conducive to smooth operation of the unit. In low-head plants the efficiency of the draft tube is a predominating factor in the over-all efficiency of the unit. Again, the factors with which a draft tube must contend are different with a propeller-type turbine than with a Francis type, even under the same general hydraulic conditions. A basis of comparison of draft-tube excellence of design must take into account all the conditions. These vary widely and have different weight under varying conditions; hence it is difficult to select any standard of comparison. In fact, it is doubtful if it is possible to set up any standard that will mean anything or that will give a true basis of comparison. After all, the over-all efficiency is the chief concern, and how this is determined is well established.

Automatic Boiler Control

EVER since the days of James Watt, the automatic adjustment of the steam supply of a prime mover to meet the momentary load on the unit has been a commonplace. Excepting locomotives, hoisting engines, ship propulsion and other special applications where hand throttle control may be necessary or advantageous, a governor has always been applied as a matter of course. The problem here is fundamentally simple. Load variations lead to speed changes, which, through the governor, control the supply of a single working substance—steam. Incidentally, the steam is used as fast as supplied. It passes through the turbine in a fraction of a second.

With boilers the problem is much more difficult—so difficult, in fact, that until recent years most engineers looked upon the automatic control of boilers as impracticable. But a few hardy souls, with the courage of their convictions, made the attempt. Thanks to their efforts there are now on the market several practical systems of automatic boiler control.

In most of these systems a single element, such as the steam pressure, is the determining factor. So far the problem is not more difficult than with the prime mover, where speed changes actuate the governing mechanism. But when a fall of pressure indicates that steam consumption is starting to run ahead of generation, it is not enough to speed up the stoker. The air flow must be increased in proportion (or roughly so). This requires increased air pressure below the fire. It also requires increased draft at the uptake if the draft over the fire is to be maintained at a low constant value.

So the automatic control not only must speed up the stoker but must at the same time make proper adjustments in the under-fire pressure and the uptake draft.

It is perhaps true that no system of control yet devised can give boiler plant efficiencies appreciably higher than those obtainable by a corps of experts under test conditions. But this is of little practical importance in the light of the fact that a properly designed and supervised system of boiler control permits the plant to approximate test efficiency in every-day operation.

According to Representative Eaton, in a recent address before the House, "Our electric light and power industry produces more than 65,000,000,000 kw.-hr. a year; . . . pays $150,000,000 annually in taxes; and with gross earnings of nearly $1,500,000,000, contrary to popular tradition, has never yet earned 6 per cent on its total investment." Judging by some of the prices recently paid for Florida utilities the 6 per cent stands in danger.

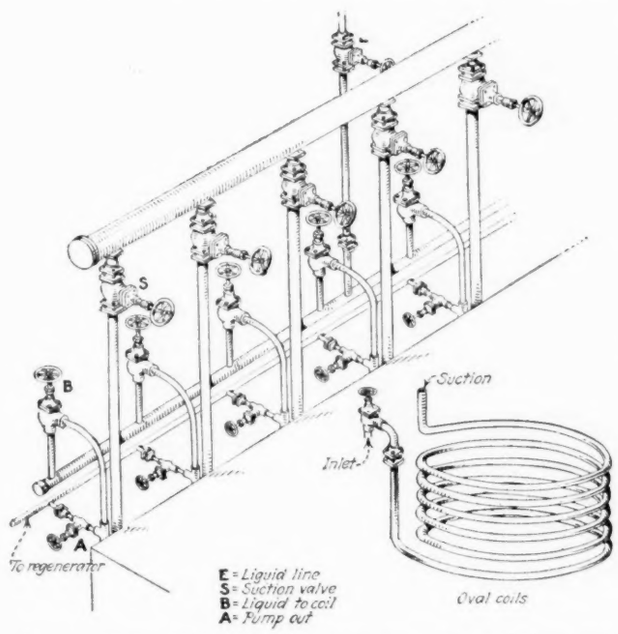
Practical Ideas From Practical Men

How the Capacity and Life of the Brine Tank Were Increased

On taking charge of a refrigeration plant I found a discarded brine tank and was told that it would be a good idea to dismantle the tank and remove the coils in order to make room for contemplated improvements. The general opinion was that they had outgrown this tank, so a new one had been built.

On checking up on the two tanks I found that both contained the same amount of pipe surface and volume of brine, although the shapes were somewhat different.

The old tank had been in service less than five years and as with only one tank there would be nothing to fall back on in case of trouble I decided to look into the old tank and see what could be done toward putting it in shape for an emergency. After removal of the brine an examination was made and the coils and tank were found to be in first-class condition.



Arrangement of connections to permit pumping out coils in brine tank

Owing to the location of the tank there was insufficient head room to permit raising the coils for internal cleaning. The coils, as shown in the illustration, being a continuous welded pipe, there was no opportunity to drain from the bottom. It was suggested that I could burn a hole in the bottom pipe of each coil for draining and after the usual steam and air method of cleaning and drying I could weld patches over the holes. This method, however, did not appeal to me.

The usual method of cleaning with steam and drying with air has never seemed just right to me, for in the majority of plants I find that the air contains too much moisture. I have always felt that the greater part of the water in the system was put there through the use of moist air used for drying and testing purposes.

I finally decided on a plan of pumping out the coils by arranging the connection shown in the illustration. The 1-in. liquid lines were broken and tees and valves put in as shown at *A*, which connected with the line that ran direct to the regenerator in the engine room. The suction valves *S* and liquid valves *B* were closed and valves *A* opened. The idle machine was started and run slowly, taking its suction from the regenerator. In this manner the coils were pumped out, giving up 290 gal. of oil and 35 gal. of water, which was sufficient to fill approximately one-third of the coils. The tank contained ten oval coils each made up of 600 running feet of 2-in. pipe.

As this provided surface far in excess of that actually required, it was decided, after putting the tank in service again, that at regular intervals the liquid valve *B* would be closed on one coil and suction valve *S* left open for a while and then closed and valve *A* opened to the regenerator and the idle machine started. With this method all coils were pumped out at regular intervals and kept comparatively free from oil without interfering with the operation of the tank. This tank gave five years more of continuous service and easily handled a 35 per cent increase in load. The cost of labor, pipe and fittings amounted to $162.

San Francisco, Calif. J. B. STAPLETON.

Misalignment Causes Belt Trouble

In Fig. 1 is shown a 500-kw. generator driven by a vertical water turbine. The unit is equipped with a belt-driven exciter, the driving pulley wheel being placed on the turbine shaft just below the generator spider

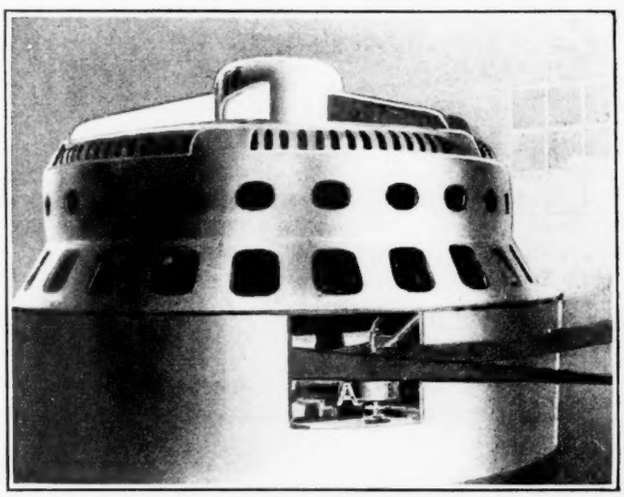


Fig. 1—Exciter belt creeps over the idler

and the belt coming out through an opening in the concrete wall. The idler pulley *A* has been added to assist the belt to make a quarter turn. The belt has a habit of creeping up over the top of the idler *A*, causing the belt to be severely cut and often put out of commission. Examination of Fig. 1 shows that the exciter is placed above the level of the large driving pulley, which at once explains the difficulty. In Fig. 2 is shown

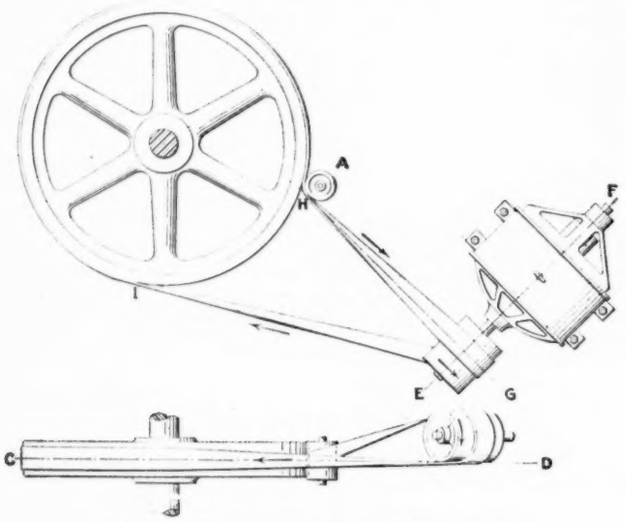


Fig. 2—Proper location of the exciter

a plan and elevation of the pulley layout. If the belt is being run as indicated by the arrows, the bottom of the exciter pulley must be level with the center line *CD* of the driving pulley. The center line *EF* of the exciter shaft must be so located that a line drawn from the point *H* on the idler *A* at right angles to the shaft *EF* strikes the center of the pulley. If these conditions are observed, the belt will travel true. On the other hand, if the belt travels opposite to the arrows in Fig. 2, the position of the exciter pulley must be shifted. The top of the pulley must be level with the center plane of the driving pulley and the shaft *EF* must be shifted so that a line from *I* making a right angle with *EF* must cut *EF* at the center plane of the exciter pulley.

Evidently in Fig. 1 the exciter was set too high for rotation in either direction. CHARLES FLANNIGAN.

Raleigh, N. C.

Repairing a Leaky Throttle Valve on a 10,000-Kw. Turbine

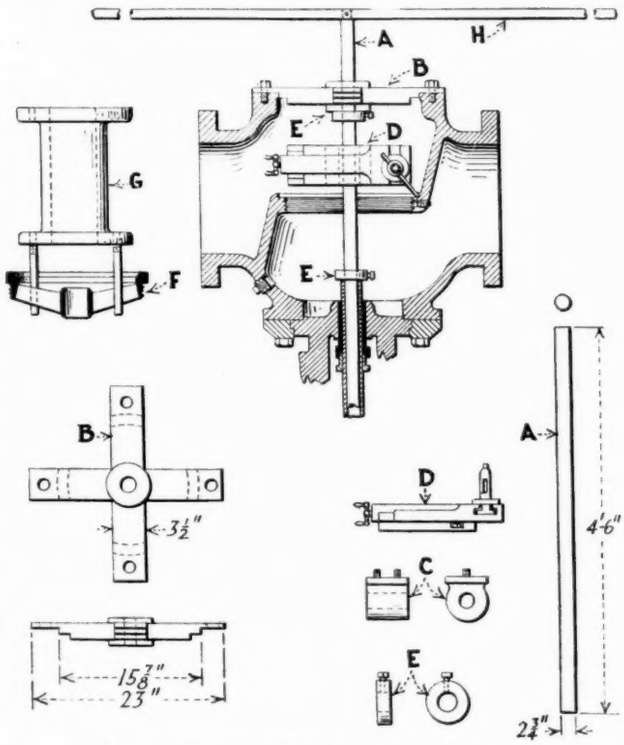
The throttle valve on our 10,000-kw. turbine leaked between the Monel seat and the steel body. The machined surface or shoulder, upon which the seat screwed down, was only about $\frac{3}{8}$ in. wide and had some sand holes or was scored by steam leaking through when the turbine was shut down. A gasket of high-pressure packing was tried between the seat and body, also a gasket of soft copper, but they kept tight for only a short time.

We then tried to rent a valve to put in the line until the leaky one could be sent to the factory for repairs, but were unable to obtain one. The station load is such that the turbine has to be in service all week except on Saturday, Sundays and holidays. Thus any repairs had to be made quickly.

With the aid of my assistant and master mechanic, a machine was designed and built as shown in the accompanying sketch, which worked out satisfactorily. We still have to use a gasket under the seat, but we expect it will hold tight for three or four years at least.

The valve was taken out of the line on a Saturday morning, blocked up in a vertical position and a working stage built around it. The top plate of the valve was then removed, the valve, stem and valve seat taken out and the stem packing removed, and then the gland was replaced.

Referring to the sketch, the machine was assembled in the following manner: The spindle *A* was passed down through the stuffing box and gland, collar *E* was put in position and held with a setscrew, part *C* was dropped down on the spindle and set up tightly with setscrew, the lathe tool holder *D* was bolted on to part *C*, upper collar *E* was put on the spindle, part *B*, which was machined to fit valve body tightly, was put into position and formed the top bearing for the spindle *A*. The top collar *E* was then set up tight so that there was no end motion of the spindle carrying the tool.



Tools used to reface valve seat surface

The handle *H* was attached and, with a man on each end, the machine was operated quite easily.

After taking off a few cuts, we got down to solid metal and a good surface was obtained. The job was completed about 4 p.m. on Sunday, without any loss of service of the turbine.

We have a 10-in. valve of the same make on which this arrangement can be used by making part *B* to fit, the spindle being the same size.

Part *G* is a short piece of flanged 8-in. cast-iron pipe, with pins in it for screwing down the seat ring. With two flange pins set in the top flange holes and a long piece of pipe for a lever, a tight job can be made. F. B. WHEATON.

East Bridgewater, Mass.

Comments from Readers

Old Type Engines

In the news item in the Feb. 2 issue entitled "Part of N. Y. City Water Works of 1799 Uncovered," a brief description is given of an old Russell engine.

In 1921 I was employed in a central station in the Finger Lakes country as watch engineer. This plant had among other prime movers two old Russell engines, similar to the one illustrated in the article referred to. These engines had a slide valve for admission and Corliss exhaust valves. They were twin cylinder engines, each being direct connected to generators of 470-kva. capacity. The engines were equipped with flywheel governors, but these were out of commission, so the engines were operated on the throttle, which kept the engineer and the oiler busy watching the board and adusting the throttles. These old engines on full load used about 50,000 lb. of steam per hour. We also had a 750-kw. turbine, and while I was there a new 1,500-kw. turbine was started and the two old engines were shut down. According to the article, the engine illustrated was made by a predecessor of Griscom-Russell Co. The engines I refer to were labeled "The Russell & Co., Massillon, Ohio."

Clinton, N. C. R. G. SUMMERS.

Gland Seals for Centrifugal Pumps

The article in the Dec. 15 issue by J. C. Hobbs on "Improvement in Gland Seals for Centrifugal Pumps," was of particular interest to me and the practical points on gland packing and water seals brought out in the article should be useful to engineers who have charge of centrifugal pumps. It occurred to me that my experience with three 1,200-gal.-per-minute, ten-stage centrifugal pumps, operating at 1,200 r.p.m. under 600 lb. pressure, might also be of interest. The weight of solids per gallon in the water that is being pumped is 0.35 oz. and this amount of grit makes it necessary for us to give particular attention to the glands. Each pump has one suction and three pressure glands. When these pumps were first put into operation, each packing box had a bronze water seal ring or lantern and the sealing water was delivered to the seals at 105 lb. pressure.

These pumps were operated in this condition for a long time, but with the high discharge pressure and the dirty water being pumped, the gland had to be kept unusually tight to prevent excessive leakage, and that caused a great amount of wear on both the packing and shaft sleeves. The packing boxes are designed so that three rings of packing can be put on each side of the water seal ring. With new sleeves the leakage is small, but as the sleeves wear it becomes increasingly difficult to maintain a tight gland. The part of the sleeve where the water seal is set does not wear, which makes it more difficult to keep the packing tight; also it is difficult to keep the seal ring in place so that the sealing water can flow freely.

We finally decided to remove the seals from the three pressure glands but to leave the seal in the suction box as it was. The gland was set so as to allow enough water to pass along the shaft to keep it cool. Eight rings of packing can now be put in the boxes, and it does not require such great strain on the gland to keep it tight. Also the sleeves last twice as long, and a big saving in packing has been made.

Norway, Mich. THOMAS PASCOE.

The Engineer as a Salesman

In the writer's opinion the engineer is a poor salesman and lacking in business acumen. Apparently he lacks the sales ability so to present a proposition to his employer that he "sells" him on the idea, or even on himself, the latter being recognized as very much a part of salesmanship.

One of the rules of selling which the engineer usually ignores is the adoption of the "you" attitude. He must be able to present his ideas by talking from the employer's needs to the remedy instead of trying to force down some technical argument when it is dollars and cents the employer wishes to hear.

An approach that leaves a trail of coal dust and oil tracks on the office rug, combined with a soiled visage and overalls that will stand alone, is enough to detract attention from the selling talk and leave the prospect in anything but a pleasant frame of mind. The engineer probably will say he is so busy running the plant that he has no time for such things. The answer to this is that if the engineer cannot so manage and train his personnel to care for the plant, freeing himself from many of the details, he always will be so busy that he can never improve his position.

After being an engineer for fourteen years and knowing them from the Philippines to Chicago, the following is the writer's impression: I can see him packing pumps, taking up bearings and cleaning oiling systems, usually with from one to three men standing around watching the operation, instead of teaching and training the men under him to be of more value to the plant and to themselves.

When asked why he does this, the engineer says it is easier to do it himself than to teach the men under him. He will not give them some of the responsibility, and in this he is a poor manager and is lacking as a business man. His explanation will probably be that he cannot get the men to give him enough help so that he can spend his time in management, which includes studying the plant for possible improvement. The answer is that his superintendent, probably on many occasions, has found the men in the plant working without system. They are idle much of the time and he feels that until his engineer can secure from his force the same maximum efficiency obtainable from the employees in other departments he cannot increase the cost of the power department by adding help.

Not until the engineer makes management his job,

instead of being a general handy man, and learns the art of presenting an idea from the manager's point of view will he become what he should be, managing head of a department.

Another part of the engineer's job that may be classed under salesmanship is securing the co-operation of other department heads by selling them the idea of efficient use of the plant products—and about one-half of this is selling himself and his plant to these department heads. To do this he must give some consideration to the needs of the various departments, because their needs are quite often a part of the engineer's business. By applying his knowledge of mechanics, of the use of steam and power to the reduction of production costs, he will find that he is selling himself to the department heads and will receive recognition as a valuable part of the organization.

Does the engineer sell himself to his men, or is he only their taskmaster? Has he sold them on the idea of efficiency, an interest in the plant, and in this way turned disagreeable tasks into interesting, result-getting training? He must remember that they will follow him and reflect in their attitude everything that he has sold them. If it is cussing the company, inefficiency, slovenliness, a dislike for work and carelessness, he will have just that many salesmen on his territory selling to all of their contacts. This being the case, how much better it is to make the men salesmen for himself and for one another, selling to others the plant as an interested, happy, efficient, clean, boosting part of the industrial machine.

L. A. COWLES.

Vermillion, S. Dak.

Burning Low-Grade Coal

On page 304 of the Feb. 23 issue, C. B. Hudson questions the advantage of burning high-volatile coal as described in my article of Dec. 8, 1925. He states that even with a price differential of $1.10 per ton, low-volatile, low-ash and high-B.t.u. coal is cheapest for a New England plant. Evidently he assumes that high-volatile coal cannot at the same time be of high heat content, but I have burned high-volatile coal running as high as 13,900 B.t.u. per pound, so high volatile content does not necessarily mean a low B.t.u. content.

His greatest error, however, lies in his statement that the hydrogen content is a detriment and that the combustion of the hydrogen results in a net loss. A review of the rudiments of combustion will disprove this statement. Taking first his own case, fuel oil of 18,600 B.t.u. content and 11 per cent hydrogen; his figure of a stack loss of 1,106 B.t.u. is correct but misleading, because his analysis is not complete.

The combustion of 0.11 lb. of hydrogen produces 62,500 × 0.11, or 6,875 B.t.u. in the furnace. This heat is generated but not all transferred to the water in the boiler. Deducting the stack loss of 1,106 B.t.u. from 6,875 B.t.u. gives 5,769 B.t.u. available for making steam. Thus by completing the analysis of the combustion of the hydrogen content, we see that there is a net gain instead of a loss by replacing a given percentage of fixed carbon with an equal amount of hydrogen. It is apparent from Mr. Hudson's remarks that he would prefer to eliminate the 11 per cent hydrogen content and replace it by 11 per cent more fixed carbon. Let us see what would happen in that case. The combustion of 0.11 lb. fixed carbon produces 0.11 × 14,500, or 1,595 B.t.u. in the furnace, and the stack loss when using 14 lb. of air per pound of fuel and assuming air enters the furnace at 70 deg. and leaves the heating surface at 500 deg. will be as follows: $14 \times 0.11 \times 0.2475 (500 - 70) = 163.732$ B.t.u. per pound of fuel. The net heat available for steam generation by burning 0.11 lb. fixed carbon is 1,595 — 163.72, or 1431.28 B.t.u.

Now we see that if we change over to a fuel with zero hydrogen content and the fixed carbon content increased 0.11 lb., there will be a net loss of 5,769 — 1,431.28, or 4,337.72 B.t.u. per pound of fuel. Removing the hydrogen content from Mr. Hudson's fuel and substituting pure carbon will lower the total heat content to about 13,320 B.t.u. per pound and the net heat content to 14,263 B.t.u. per pound of fuel. The stack loss from the combustion of the hydrogen of 1,106 B.t.u. is not so large as Mr. Hudson makes it appear, being only 16 per cent [1,106 ÷ (0.11 × 62,500)]. The stack loss from burning pure carbon runs from 12 to 18 per cent depending on the amount of excess air used, but do we ever hear any one claiming that the fixed carbon content in coal is a detriment? Suppose we increase the hydrogen content in the fuel oil under discussion from 11 to 15 per cent. This raises the total heat content per pound of fuel to 21,020 B.t.u. per pound by substituting 4 per cent hydrogen for an equal quantity of fixed carbon. Whether it could be successfully burned in the same type of furnace is another matter. If high-furnace temperatures exist and good mixture occurs, it can be burned with sufficient furnace volume.

Taking up the question of securing lower steam costs with the high-volatile coal at $7 per ton as compared with high-carbon, low-volatile coal at $8.10 per ton, I shall give more space to a description of the combustion process than my first article contained. The two grades of coal were about equal in heat content, according to the dealer's statement. We had no ultimate analysis made, but were told that the coal under discussion was high-volatile coal and the hydrogen content was shown to be high by the fact that it was a caking coal. The volatile was more than 30 per cent by the proximate analysis and the hydrogen content found by formula was more than 5 per cent and from charts the percentage of volatile carbon was found to be 19 per cent.

These calculations proved conclusively that a much higher evaporation could be obtained by burning this coal completely, even though other local plants condemned this fuel on account of the caking qualities and the black smoke caused by insufficient furnace volume and reduced capacity of their boiler when using this coal. The caking trouble could be minimized by light firing, and even firing only four scoops of coal at a time the fuel bed would form into coke islands with irregular fissures running between them. A few minutes after coaling these coke islands would be high, due to swelling and getting no air, and thin spots would form along the sidewalls and in the corners. The fires were always leveled with a rake about five minutes after firing to break up the coke islands and insure a uniform air supply. One side was incandescent all the time, and it was our practice to throttle the hand damper when leveling fires, as the cold air entering the furnace with a wide open damper caused a reduction in the furnace temperature and also caused a reduction in the draft over the fire on the boiler on each side of the one being fired.

Mr. Hudson would like to know what result would be obtained by following this practice with the high-grade coal. It can be seen from the previous article that when the firemen started with the low-priced coal they fired in the same way they employed with the first coal, which gave a daily fuel cost of \$7 × 22, compared with \$8.10 × 20, or a saving of \$8 daily. This saving was the manager's reason for refusing to go back to \$8.10 coal.

The changes in furnace design and firing methods were undertaken with a view to eliminating the difficulty experienced by the firemen in holding the steam pressure and to stop the production loss due to low steam pressure. Uniform distillation of volatile, high temperature at the time of greatest distillation and good mixing effected the reduction of three tons daily after the furnace was redesigned for this particular fuel.

ANDREW F. SHEEHAN.

Brightwood, Mass.

Engineering and the Man

The letter of H. D. Fisher in the March 2 issue on "Engineering and the Man" brings out some points of considerable interest.

Undoubtedly, a certain amount of practical experience with the conditions existing in the industries is of great value to the college student, but I am not at all sure that its chief value lies in the fact that apparently a recent graduate who has had such experience is of greater immediate value than one who has not. I am rather inclined to think that this inference is based upon an erroneous assumption as to just what industry may reasonably expect of the colleges.

There is reason to believe that the chief value of a certain amount of practical experience gained by the student during his time in college is the insight it gives him into the actual conditions he is preparing himself to face and the realization of the fact that the required studies are not merely feats of mental gymnastics, but are designed to develop mental tools that he will use in his life's work.

There seems to be a more or less general assumption that the colleges should turn out engineers in complete operating condition in four years, whereas in bygone times it was considered that whatever theoretical knowledge a man might have, an apprenticeship of four or five years was necessary to make a junior engineer of him.

Modern conditions perhaps do not demand that an engineer should be a skilled mechanic; at the same time some experience in the actual carrying out of mechanical operations is certainly advisable. The field of scientific knowledge and its application to engineering has widened so greatly during the last half century that it is doubtful whether one can reasonably be expected to obtain much more than the necessary minimum of such knowledge in four or five years. To expect a man to do that and at the same time to gain any real efficiency in the practical application of that knowledge does not appear to be entirely reasonable.

There is great danger that if we cut into this all too limited period to teach a man the practical things that he can learn after graduation we may be doing more harm than good.

Of course this does not apply to vacation work, and I am not unmindful of the good work being done by some of our co-operative schools. At the same time I am of the opinion that the real solution of the problem lies in a more general recognition on the part of the engineering industry of its obligation to offer to the graduate student the best possible facilities for completing his professional education, of which the colleges can furnish only a part.

Mr. Fisher has referred to the lack of commercial success often experienced by the engineer. I am much afraid that this condition is not being improved by the attitude in which some of us older men are meeting the natural expression of ambition of those younger than ourselves.

In other professions we find a different attitude. In law, for instance, we find a general belief among its practitioners that the legal profession is one of great honor and authority, and why should it not be so? We find lawyers holding the highest offices in the country, and the older men not only expect but encourage the younger men to equip themselves to take their places when they are gone.

In medicine we find the established physicians standing together to maintain the dignity and emoluments of their profession and looking askance at the young man who fails to stand shoulder to shoulder with them, but what of the engineer?

The future of our profession is in the hands of the young men, and if to a certain extent we have failed to take our rightful place in the community and reap the legitimate rewards of our industry, the least we can do is to throw the weight of our experience on their side and encourage them to retrieve the ground lost.

Newark, N. J. J. O. GIBBONS.

Economic Condition of Engineers

With reference to the articles by U. Wieland Los on "Surplus of Engineering Graduates an International Phenomenon" and by E. Ogur on "Engineering and the Man" in the Jan. 5 issue, it is generally recognized that the cause of the present unsatisfactory condition is the "law of supply and demand" now operating with a condition of great supply and nominal demand.

This condition presents a problem at least as old as recorded history. Within the memory of many of us the professions of medicine and law faced conditions that were much worse than that of engineering today. Their condition was brought about because the colleges had little else to offer in professional training. It is to be noted that the economic situation of these professions has greatly improved within recent years, and the change was brought about by a restriction of the supply in relation to the demand (1) by raising the standards of the professions in the colleges, which operated to restrict the number who could take up the courses and also the number of graduates; (2) raising the standards of bar and practice examinations; (3) development by the colleges of a multiplicity of courses that offered better prospects to the students.

The farmers of the Middle West are struggling with the same problem in a little different form, and are appealing to the federal government to devise some way to take the excess supply off the market.

Bricklayers are "making" \$12 per eight-hour day in most cities now. Carpenters are paid much less, although a good carpenter is much better trained than a bricklayer—and frequently lays out the work for him.

There can be little doubt that this situation has been brought about because bricklayers have restricted the supply of apprentices, whereas every man who can use a hammer and a saw is a potential carpenter. The statement has been made that the bricklayer is injuring himself by these tactics, but on a strictly dollars and cents standpoint he is about 99 per cent winner, because the effect of his own increased wages to increase his own rent and cost of living is a small fraction of what he gains.

Now what can be done to take the downward pressure of the surplus of engineers off the pay checks? Mr. Ogur advocates closing 80 per cent of our technical schools. There is no doubt that mistraining and misrepresentation are responsible for the wasting of many years of many lives, aside from the creation of much bitterness and disappointment. It seems to be true that many professors of engineering are little concerned with the economic side of anything, although the basis of existence of engineering is its economic value to civilization; without that it would all go back into the laboratory.

In the final analysis, all activities consist only in moving things about; the changes of all relationships and forms come into being only by *movement* of the basic matter (energy). Is not that a concern of engineering?

The running of a city is about 90 per cent engineering. The water supply, traffic problems, fire protection, street cleaning and lighting, pavements, sewers—about 90 per cent of the money is spent in those directions, yet engineers have relatively little to do with them.

In almost any industrial activity you may take up, engineering should have an important place. My suggestion is that these surplus engineers be placed there. They would be assimilated without the least disturbance. They should be just what those industries need, but are they?

Some seem to be, but many are not. Why?

I submit that in many cases it is because they are crammed with a lot of fixed knowledge, which quickly becomes obsolete. To illustrate: the classes of 1908 and thereabout were taught that the future of power engineering was in gas producers and gas engines. The large plant at Gary, Ind., was held to be an example of what should be. I do not mean that all college professors were of that opinion, but many were. I recall a textbook on steam turbines that devoted by far the greater part to extolling the merits of the vertical-shaft steam turbines. Luckily, just as we finished the book we learned that the only manufacturer of that particular type in the United States was discontinuing it. I recall especially the long mathematical discussion relative to the design of the vertical thrust bearing for that turbine.

My point is that it is the laws of change with which the embryo engineer should spend the most time, and not the particular state of things at any one time, except in relation to the state at other times. In other words, it is the fundamental tools he uses in his consideration of the gas engine or vertical turbine that matter most. Those principles do not change. He can apply them anywhere.

John Burroughs, naturalist, said, "Nature is concerned mainly with the game, not with the stakes." It is the knowledge of the game of making things better that seems to matter most. Knowledge of how someone else is making things now, or made them in the past, is of value only in that connection. All that means training to think straight from recognized facts. That kind of training may be used anywhere. It is in demand. Why is it not applied?

Well, some do apply it. Here is an engineer who left the power house and strolled out into the factory. He saw a belt, applied badly, that was interfering with production. He remedied the trouble. He is now general manager of that company, and there is room for one more engineer in the power house who would otherwise be in the surplus. Another engineer goes into the retail coal business, which is largely a matter of handling materials cheaply and selling people the right kind of fuel. Room for another one. Another goes into the baking business and puts in a continuous oven with temperature recorders, etc., which take much of the old guesswork out of the business. He devised a better distributing system. Another engineer less in the surplus!

Broader training in the essentials—the laws of change for the better—a good philosophy of life. Then they will tackle anything that betters the economic condition of mankind, and their own condition will be bettered thereby.

J. R. BELKNAP.

West Toledo, Ohio.

Checking Watt-Hour Meter Connections

After a careful reading of the interesting article entitled "Checking the Accuracy of Watt-Hour Meter Connections," by Willard F. Walsh in the Feb. 9 issue of *Power*, it seemed to the writer that the final paragraphs dealing with the subject of testing for reversed connections to the separate elements of polyphase watt-hour meters should have been made more complete by the addition of a few words on the effect of the power factor of the load used when making the test.

It is probable that the instructions given in the article will be used by plant engineers who have never had the opportunity of studying the subject of alternating-current metering and who might be led astray by throwing a lightly loaded induction motor, or a bank of transformers without any load at all, on the line to give a load for the purpose of checking the direction of rotation of each element. Such a load would invariably have a power factor of less than 50 per cent and with a properly connected meter, the meter elements would be found to rotate in opposite directions when testing by opening one potential connection on each in turn.

A polyphase watt-hour meter with two elements is, in reality, nothing more or less than two single-phase watt-hour meters with their rotating parts mechanically fastened together, and its performance may easily be understood by noting the simultaneous performance of two single-phase watt-hour meters connected to measure the energy flowing in a polyphase circuit under different conditions. To ascertain the effect of power factor, assume two single-phase watt-hour meters connected in a three-phase circuit having balanced loads on each phase at 100 per cent power factor and then gradually decrease the power factor while keeping the balanced-load condition. We shall find that at 100 per cent power factor both meters will rotate in the same direction and at the same speed. Decreasing the power factor gradually will cause one meter to speed up slightly at first and then gradually slow up, whereas the other immedi-

ately begins to slow up and stops entirely when 50 per cent power factor is reached. Still further decrease in power factor will continue to slow up the speed of rotation of the first meter, and the other will begin to rotate in the reverse direction with gradually increasing speed until at zero power factor the two meters are again rotating at the same speed but in opposite directions.

From the foregoing it will be apparent that in checking the correctness of polyphase watt-hour meter connections by noting the direction of rotation of each element when connected separately, it is absolutely essential to consider the power factor of the load. Loading with a water rheostat as mentioned gives a power factor of practically 100 per cent, but quite often this method of loading will be found to be inconvenient on account of the current transformers having large ratios, necessitating heavy primary currents, and under such conditions it is far easier to use an induction motor load, the power factor of which can be varied sufficiently by changing the load on the motor or motors to get at least one condition above and below 50 per cent power factor respectively. The writer's method of making this test is first to observe the direction of rotation of each meter element alone with one or more induction motors running without any load—that is, with belts thrown off—followed by another observation with one or more well loaded motors running. It is, of course, necessary to disconnect all loads other than the motor or motors used for loading the meter while making the test.

FRANK G. PERLEY,
New Britain, Conn. Industrial Power Engineer.

Modern Pumping Engines in Holland

My attention was drawn by an abstract in the July 7, 1925, issue of a paper I read in the Institution of Engineers and Shipbuilders in Scotland. The title, "High Efficiency Pumping Engines," given to this abstract is somewhat misleading, as the mean lift of the eight centrifugal pumps discharging 20,270 cu.ft. each was 18⅞ in. only at the trials and no pump working with such a small lift can be expected to have a high efficiency, whatever the pump system may be.

That the title "High Efficiency Pumping Engines" is really misleading was shown by the letter of G. van den Berg in the Sept. 22, 1925, issue. Mr. van den Berg rightly observes that a total efficiency of a steam pumping installation, w.hp. ÷ i.hp. = 0.275, is not to be called a high efficiency, but it should not be directly compared with the efficiency of pumps with higher lifts.

Adopting a mechanical efficiency of e.hp. ÷ i.hp. = 0.9 for the steam engines, the efficiency for the centrifugal pumps is w.hp. ÷ e.hp. = 0.275 ÷ 0.9 = 0.306. The losses from friction, whirling, shock and velocity head at the discharge amount to 100 — 30.6 = 69.4 per cent and represent a head of water of 0.694 ÷ 0.306 × 18⅞ = 42.8 in.

It is my opinion that this total loss in the pumps and the adjoining pipes is not too high, considering that at the trials the pumps were not working under favorable conditions, as they were designed for a lift of about 3 ft. During the trials the lift varied from 2 ft. ⅜ in. to 1 ft. 7$\frac{13}{16}$ in. only, but the opportunity of making any trials at higher lifts did not present itself at that time.

PROFESSOR DIJXHOORN.
Delft Technical University.
Delft, Holland.

Convenient Engineering Units

The letter of Louis Elliot in the Feb. 16 issue and the one of James A. Harris in the Feb. 23 issue proposing a new symbol to represent a unit of evaporation equivalent to 1,000 B.t.u. are steps in the right direction for the establishment of a needed symbol and equation in combustion mathematics.

I desire to delineate somewhat upon the matters discussed by Mr. Harris with reference to the Roman numeral M (1,000) and the letter K, the latter being the abbreviation for the ancient Greek word kilo, meaning 1,000.

I would immediately eliminate in this discussion the combination of the letter K in any term, for the reason it has become so closely associated with all electric-current measurement that any utilization of it with any part of B.t.u. would tend to lead to confusion and misinterpretation.

Since the letter T is the first letter of the word temperature or thermal and the middle letter of the symbol B.t.u., thereby representing the controlling feature of that unit, and since the Roman numeral M, when placed to the right of a combination of letters, represents 1,000 units, I suggest that the symbol TM. be adopted.

This symbol, in my opinion, contains the following worthy attributes: it is concise and easily written, represents in meaning the components of 1,000 B.t.u. and is euphonic and readily spoken.

Would not this be a useful and beneficial equation in combustion mathematics—1,000 B.t.u. = 1 TM.?

I think it is worth consideration.

Anderson, Ind. GEORGE S. BILLMAN.

Exhaust Versus Live Steam

The letter, "Exhaust Steam Versus Live Steam for Heating," by John G. Smedley, Jr., in the March 16 issue brings to mind a pertinent incident.

A manufacturer of silica brick in a southern Pennsylvania town furnished the town with current for light and power, using the exhaust steam from the engines in the coils attached to the fans that supplied the hot air to the kilns for drying the brick.

I was present when the representative of a hydraulic power company made the brick company a proposition to furnish it with service, and was surprised at the reply of the manager of the brick company. This was to the effect that it required more coal to dry his brick with the electric plant shut down than it did when it was running. If the hydraulic company wished to furnish him service, it would have to pay him for the privilege.

I have discussed this problem with engineers experienced with fan heater systems and am advised that this is in line with their experience. The explanation advanced is that the pulsation of the engine exhaust improves the circulation in the heaters by preventing the forming of air pockets, which cause cool spots, which in turn cause uneven heating of the air passing through the fans.

The effect on the heating system would be the same. Even distribution of steam throughout the active radiation would avoid the overheating of some parts of the building in order that other parts would be brought up to the standard.

H. A. WARD.
Ithaca N. Y.

Questions and Answers

Cutoff in Duplex Pump

How would one change the cutoff in a duplex pump?

In direct acting duplex pumps, there is no steam cutoff, it being necessary that the steam follow the piston for full stroke, because the water pressure against which the pump is working is the same throughout the entire stroke. The steam valve may be adjusted to shorten the stroke of the pistons, but not the "cutoff" as questioned.

Remedy for Sweating Roof Tiles

A certain power house is roofed with red terra-cotta tile put up about twenty years ago. The manufacturers claim the roof is good for another seven or eight years. But the inside surface of the tile is flaking off in small, white particles, which drop on the machinery and floor, making it impossible to keep the place tidy. At times quite a bit of condensation collects on the inner surface of the tiles. The result is a precipitated liquid, which eats off paint wherever it drops in the room. Air cleaning the inside surface of the tiles, cleaning with a wire brush and coating with a roof paint have all been tried to no avail. There seems to be no known remedy for the difficulty. Can you suggest one?

Put in a false roof of beaverboard, or ceil the room with beaverboard. In either case make an air-tight job that will reach under the total roof area. This will make an air pocket that will prevent the collection of condensation either on the ceiling or on the old roof tile.

Mechanical Efficiency of a Turbine

What is the mechanical efficiency of a good steam turbine and how are the losses divided?

The losses in a steam turbine may be classified roughly as follows: (1) Steam friction in nozzles and buckets and disk "windings"; (2) leaving loss, due to high-velocity exhaust steam; (3) radiation of heat; (4) leakage of steam; (5) bearing friction.

The first of these is partly recovered in a multi-stage turbine, since friction in any stage reheats the steam slightly and increases its capacity to develop work in the next stage. The net loss is considerable, however, and may be from 15 to 20 per cent of the work available from the steam. The leaving loss may run up to 5 per cent. Radiation and leakage together should not exceed 1 per cent, and bearing friction is usually less than 1 per cent.

It is not easy to say what the mechanical efficiency of a turbine is, since there is no established definition for the term. Of course there is no such thing as indicated horsepower for a turbine, so that an efficiency of this sort must be determined from the losses. If allowance is made for bearing friction only, the mechanical efficiency must be set at about 99 per cent. It is difficult to justify the inclusion of any other losses in mechanical efficiency. All of these losses are covered in the aggregate by the "engine efficiency," which is the ratio of the work actually developed at the turbine shaft or at the generator terminals to the work theoretically available from isentropic steady-flow expansion of the steam.

Expansion Joints and Traps

A steam line must be run to serve a building 1,200 ft. long, divided into eight sections of 150 ft. Rubber rolls will be located in some sections, whereas the others will need steam for heating only. The rolls require 80 lb. steam pressure, which is the existing high pressure, and the steam heat will be served with low-pressure steam (under 10 lb.). One line will be run for both classes of service, using the high pressure direct on the rolls, and feeding the heating supply lines through reducing valves. How far apart should expansion joints be spaced on the main? What high-pressure traps are the least expensive?

One expansion joint for every 250 ft. length of steam line will serve the purpose, if it is so designed as to take up 4 to 6 in. of linear expansion. This amount allows for all contingencies of cast-iron fittings, steel or iron pipe, etc., and is a maximum allowed by practice. Traps of the bucket type are the least expensive to buy, but not always the least expensive to operate.

Setting Valve Rods and Eccentric

With the engine on center and eccentric 90 deg. from the crank, what should be the length of eccentric and valve rods?

The shortest answer, and to the point, will be: "Just long enough to center the valve or valves over the ports and in their travel." It can be added that the eccentric would then be advanced in the direction of rotation from its 90-deg. position (with the crank on center) far enough to overcome lap and give lead. This applies only where there is a direct valve motion—that is, no rocker arm between eccentric and valve.

With a rocker arm in service, the eccentric is moved back opposite to the direction of rotation an amount sufficient to overcome lap and give lead.

Metering and Sale of Steam

What is the best meter for measuring steam sold? How is steam sold and what is the price to charge?

There are several reliable types of steam flow meters. For sale of steam the meter should record and integrate. The New York Steam Co. sells steam by the thousand pounds. Its rates are as follows:

After establishing a minimum rate per month, the rate is 90c. per 1,000 kals (a kal is equal to a pound), for the first 50,000 kals and 50c. per 1,000 kals for the remainder of the minimum demand. For all excess over the minimum the rate is 75c. per 1,000 kals for the first 3,000,000 kals and 55c. per 1,000 kals for all over 3,000,000 kals.

In order to meet the changing prices of coal fuel, an

addition to or subtraction from these charges is made in the following manner: Surcharge on coal rate, 1c. per 1,000 kals for each 10c. variation in the price of coal from $3.35 per gross ton for anthracite and $4 per gross ton for bituminous.

The minimum demand must be established by the company selling the steam. Generally, it is the average use of steam by the customer for the four summer months of the calendar year.

Changing Bearing Bracket and Rotor of an Induction Motor

If the end frames and rotor on a three-phase induction motor were reversed, what effect, if any, would it have on the operation of the motor?

Interchanging the end frames and reversing the rotor of a three-phase induction motor should have no effect on its operation. After making the change, check up and see if the rotor core can line up with the stator core. If the rotor is free to do this, then the motor should operate all right.

Cause of Leaks in Water Main

In an Oklahoma town is a water system supplied by two water tanks, situated about 2,000 ft. apart and connected into one main. The nearest tank to the town is about three miles distant. One 120,000-gal. tank is 12½ ft. from ground level to top, the 60,000-gal. tank comes an even 120 ft. from the level. The drop from tanks to town streets is 67 ft. Hammer develops and keeps joints leaking that stood a hydrostatic pressure of 150 lb. What is the cause and cure of this water hammer?

It is not stated whether there is a pumping station in town. The head would indicate that there is none. The trouble may be due to one or all of the following causes:

1. If there are pumps, hammer may be due to lack of air-chamber cushioning space.
2. Insufficient capacity of pump or mains, or both.
3. Air pockets in line from tanks and town.
4. Heavy draws on the system, which are suddenly stopped.
5. Too small mains, either coming to or in the town, or both.

Effect of Changing to Anthracite

A certain plant has been using a high grade of soft coal, but is now going to use No. 2 buckwheat. Will more or less coal be used on grates of the same size? What changes will be necessary in grates, draft and thickness of fuel?

A change from bituminous to anthracite coal will ordinarily increase the fuel consumption for the heat value, hence the evaporation is lower with anthracite than with a good grade of bituminous coal. This is on the assumption that each fuel is burned with equipment specially adapted to its characteristics.

To burn No. 2 buckwheat the air spaces in the grates should not be wider than ½ in. To maintain boiler output, increased grate area will be needed. If the grate area is not increased, one is more likely to need the assistance of mechanical draft. That may be needed in any event, when changing over to the anthracite fines, for they require more draft. The anthracite fuel bed will reach its depth limit at 6 in. as a rule. Bituminous fuel cokes up to 14 or 16 in. depth and the coked fuel pushed back and over the grates often can and does reach 8 in.

Changing from Induction to Synchronous Motors

Will satisfactory operation be obtained from modern synchronous motors of 50-hp. size? Out of a total load of 3,000 hp. of induction motors at a power factor 0.85, what benefit should be expected from the substitution of eighteen 50-hp. units? What arrangements would have to be made for excitation? There would be practically no starting torque required. What efficiencies would be obtainable at three-quarters, one-half and full loads?

Satisfactory operation can be expected with synchronous motors of 50-hp. capacity. If you have a load of 3,000 hp. of induction motors operating at a power factor of 0.85, it would not be advisable to substitute eighteen 50-hp. synchronous motors for the same number of induction motors. A power factor of 0.85 would be considered good and it would be difficult to justify the replacement of fifty of these motors with synchronous machines, even though it might raise the power factor to unity. If extensions were being made to the plant, then it would be advisable to consider the installation of synchronous motors instead of induction motors. Such changes as suggested in the questions should not be made without careful study by someone who is capable of going into the economies of the whole problem.

Where synchronous motors are used, they are generally equipped with their own exciter. The efficiencies obtained for synchronous motors are about the same as those for induction motors, except for slow speed machines, in which case the synchronous motor is superior to the induction motor.

Method of Guying Steel Smokestacks

How many sets of guys (four to each set) should be used on steel stacks ranging from 24 in. to 60 in. diameter and 50 to 125 ft. high? Where should the guys be attached? What size of wire should be used?

Steel stacks less than 75 ft. high are generally designed to support only their own weight. Wind pressure is taken by from three to twelve guy wires making an angle of 45 deg. with the stack. The guy wires should have a minimum thickness of ½ in. Their arrangement depends on the height of the stack. Stacks less than 60 ft. high need but one set of three or four guys attached at about two-thirds the height; stacks from 60 to 125 ft. high should have two sets of four guys each attached at two-thirds and four-ninths of the height; stacks more than 125 ft. high should have three sets of four guys each, attached at a point 12 ft. below the top of the stack, at a point three-quarters of that height and at a point one-half of that height.

Power Required to Drive a Generator

To limit a plant with 200 lamps of 16-candlepower each, what amount of mechanical energy would have to be available for conversion into electricity?

Assuming that the 16-candlepower lamps have a rating of 25 watts, the 200 would take $25 \times 200 = 5{,}000$ watts. If it is assumed that the generator has 85 per cent efficiency, the power required to drive it is equal to $5{,}000 \div (0.85 \times 746) = 8$ hp., approximately.

German Power Systems

By Dr. Arthur Hamm

THE centralized supply of electricity in Germany is in the main furnished by three large ring networks operating at 100,000 volts—that of the Bavarian water-power plants in the south, the Rheinisch-Westfalische steam plants on the left bank of the Rhine, and the Elektrowerke, Ltd., of central Germany. The steam plants burn mostly lignite. The eastern part of Germany, which includes the industrial province of Silesia, has not yet a uniform network and is supplied by several important power plants at 40,000 and 60,000 volts. These plants burn bituminous coal. The foregoing networks will be linked together by a few important lines operating at 220,000 volts, the first of these now being in the course of erection.

At present nearly half of all the electrical energy generated in Germany comes from lignite. Those power plants that burn bituminous coal are becoming more and more the source of supply only of the local peaks, whereas the brown-coal power plants carry the base load.

The system of the Elektrowerke, serving central Germany, is supplied by three large mine-mouth power plants, one of which is shown in the accompanying photograph. These three plants comprise more than 310,000 kw. installed capacity. That at Zschornewitz, with 160,000 installed kilowatts, is still the largest of these plants and was the largest power plant of Germany until the Goldenbergwerk of the Rheinisch-Westfalische Elektrizitatswerk put into operation its two new turbo-alternators of 50,000 kw. each. The Elektrowerke, with an annual output of one and one-half to two billion kilowatts, is Germany's largest source of electrical current. It was established as a concern of the German Government in order to supply electricity to the chemical industries of Bitterfeld, Piesteritz and Berlin, which at present are still large consumers. After the war the Elektrowerke undertook to secure the electrical load of Greater Berlin, which supply was in danger in consequence of the scarcity of coal at that time. The chemical industry demanded the main load and made possible an economical load factor.

State Power Plants Carry Large Share of Load

The second largest source of electrical energy from brown coal in the central German network are the government stations of the State of Saxony. The main power house is located at Hirschfelde (near the Hercules coal mines) and has 85,000 kw. installed capacity. As a part of this system the old central stations at Leipzig and Dresden, which burn bituminous coal, handle mainly the peak loads.

Lately the smaller power houses have been credited with a larger place in the supply of electrical energy. They have the advantage of small independent networks, with greater freedom from disturbances, the use of refuse heat, Diesel engines, high-pressure steam, etc., all of which make it possible to secure high efficiency, even with smaller units. The principal advantage of the large power plants, with their corresponding supply districts, is the higher load factor. Moreover, only the large power plants are associated with the use of the higher voltages which are the premise for locating the power house at the point of least expense, either where there is water power or at the coal mines.

Navy Yard Needs Detail and Design Draftsmen

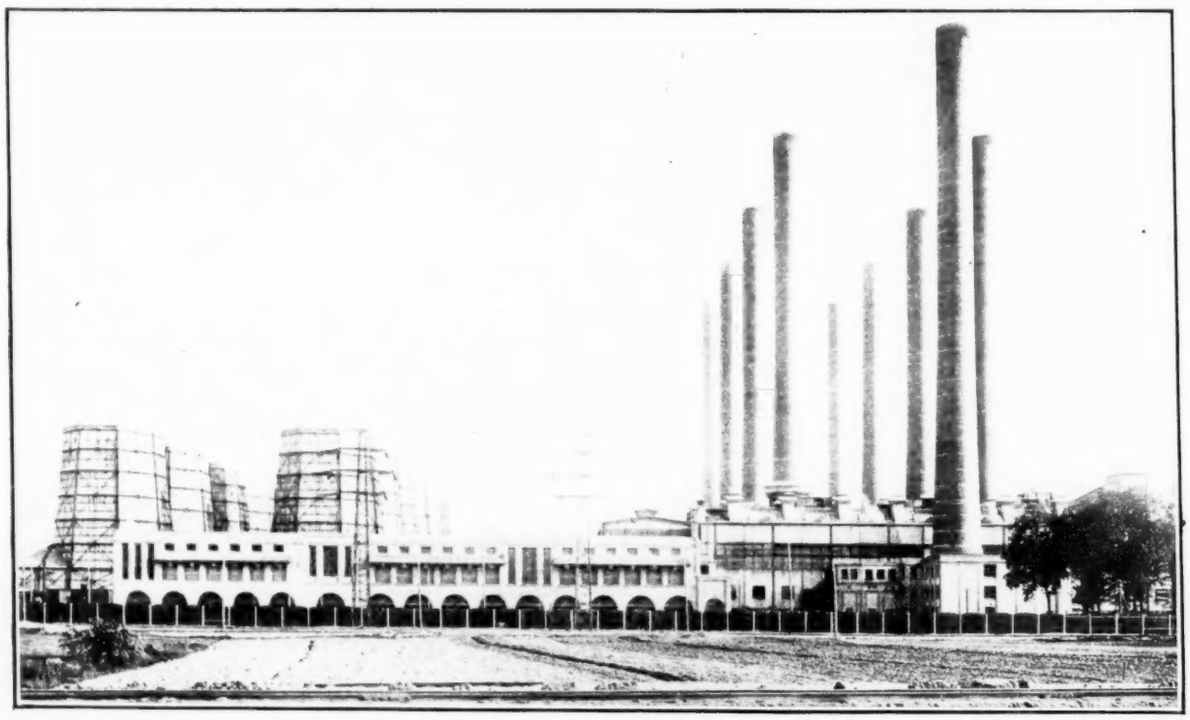
Detail draftsmen are urgently needed for marine engine and boiler, marine electrical and ship-piping work for the Washington, D. C., and the Norfolk, Va., Navy Yards, according to an announcement made by the United States Civil Service Commission. Salaries range from $5.84 to 7.60 a day.

Design draftsmen are also needed for ship and ship-piping work. The salaries for this class range from $8.08 to $10.16 a day. Applicants will be rated on their education, experience, fitness and specimens of their work. Information and application blanks can be obtained from the Secretary of the Fourth U. S. Civil Service District, 1723 F St., N. W., Washington, D. C.

Chelan River Project Gets License

The Chelan Electric Co. of Seattle has been authorized by the Federal Power Commission to develop the power resources of the Chelan River. The license will contain conditions intended to protect the scenic beauty of Chelan Lake and its value as a recreation center.

The project involves the construction of a dam across Chelan River at the outlet of Chelan Lake. This will create a head of 380 feet and will permit the development of 57,000 hp.



The Golpa plant at Zschornewitz, with 160,000 kw. installed capacity, is the second largest station in Germany and operates on brown-coal exclusively. Being a mine-mouth plant, with limited condensing water, it employs large cooling towers.

News in the Field of Power

Shoals Committee Will Have Interdepartmental Advisers

Following the appearance before the Joint Committee on Muscle Shoals of representatives of the Union Carbide Co. and of the American Cyanamide Co., some doubt is being expressed as to whether or not any bid will be submitted. It is regarded as certain that no one will propose to manufacture 40,000 tons of nitrogen, as it has become increasingly apparent that any fertilizer manufactured at Muscle Shoals will be at a loss. There also is doubt as to the market's ability to absorb that amount of additional nitrogen at this time.

The thought on the part of the Joint Committee that it might be well to retain General Lansing H. Beach as an expert adviser, and to employ former Representative McKenzie, has been abandoned. The Secretaries of War, Interior, Commerce and Agriculture were consulted in regard to expert advice and as a result an interdepartmental committee has been set up composed of O. C. Merrill, executive secretary of the Federal Power Commission; Paul S. Clapp, executive assistant to Secretary Hoover; Major James H. Burns, Ordnance Department; Dr. Elwood Mead, Commissioner of Reclamation, Interior Department. Major Max Tyler, the district engineer at Muscle Shoals, has been ordered to Washington to sit with the committee.

Joint Congressional Committee To Have Open Hearings

The discussions before the Joint Committee are in executive session, but it is understood that the Union Carbide Co. has suggested a proposition which will include rights for power development on the upper Tennessee. Senator Deneen, the chairman of the Joint Committee, states that after the conclusion of the informal conversations with prospective bidders that a series of open hearings probably will be held.

Senator Norris expects to spend several days at Muscle Shoals during the week of April 5.

The advisory committee to the Joint Committee has submitted certain general specifications which that committee believes should be complied with by all bidders. Whether or not the committee will make use of these specifications is not known. It is thought that some members of the Joint Committee are disappointed because of the disinclination of the Senate to appropriate funds for the employment of an outside expert. For that reason they may not take kindly to the reference of problems to the interdepartmental advisory committee.

Senator Deneen, it is apparent, is making every effort to direct the work of his committee along constructive lines. This is his first important assignment since having become a member of the Upper Chamber and he is particularly anxious that the task assigned the committee be well done.

Increased Power Demands Apparent in the South

In two sections of the southern United States it has been found necessary to add considerably to the central station facilities this year. In Florida two new stations are being built, totaling 75,000-kw.; and in Texas additional turbines, also totaling 50,000 kw., are being added to the central stations of Dallas and Houston. Twenty-five-thousand-kilowatt turbines are being obtained in three cases, and two 12,500-kw. units in the fourth. All will be furnished by the G. E. Company.

The Phoenix Utility Co. is obtaining, for the Florida Power & Light Co., two 25,000-kw. turbines for Ft. Lauderdale. These machines are rated at 375-lb. operating pressure, 700-deg. total temperature, 2-in. back pressure, 13,800 volts, 60 cycles, and 1,800 r.p.m. This new station, now under construction, is located on New River.

Two 12,500-kw. turbines are being obtained by the General Engineering and Management Corp. for the Florida Power Co. at Dunnellon. The units are rated at 275-lb. operating pressure, 250-deg. superheat, one inch back pressure, 6,600 volts, 60 cycles, and 1,800 r.p.m. The same company is erecting a 17,000-kw. plant at Benson Springs.

The Houston Lighting and Power Co. is adding a 25,000-kw. unit to its Deepwater plant, which now has an installed capacity of 40,000 kw. The unit is rated at 335-lb. operating pressure, 650 deg. total temperature, 2-in. back pressure, 12,000 volts, and 60 cycles.

The equipment of the Dallas Power and Light Co. at present includes five G. E. turbines as follows: One 20,000-kw., one 7,500-kw., one 5,000-kw., and two vertical 1,500-kw. units. The new 25,000-kw. unit will be placed in the space now occupied by the two vertical turbines. The new unit is rated at 325-lb. operating pressure, 650 deg. total temperature, 2-in. back pressure, 13,800 volts, and 60 cycles.

There is also being installed a 70,000-kw. steam plant at Bucks, N. C., for the Southern Power Co. The Reynolds Tobacco Co. is putting in a 5,000-kw. industrial central station at Winston-Salem, N. C. The public utility company at Perry, Florida, is erecting two oil engines. The two 2,200-hp. Diesel engine sets that were originally purchased for installation in the Hollywood, Florida, light plant, will be installed in the Punta Gorda plant of the Florida Power & Light Co.

New Rotorship Sailed for America on March 31

Flettner's rotorship, the "Buckau," left Kiel Harbor on March 31 for New York on the first real test for seaworthiness of this type of ship. Before sailing the vessel will be rechristened the "Baden Baden."

The inventor, Herr Flettner, will witness the departure, but will travel to America in a faster craft in order to interest American shippers in his project before the arrival of the "Baden Baden." The voyage across will require at least twenty days for the rotorship, but greater speed is predicted for a 3,000-ton vessel being built by the German Government and equipped with three rotors, each 120 feet high and 30 feet in diameter.

The Flettner ship will carry lumber.

Blue Asbestos a Good Heat Insulator

The ideal boiler and pipe covering does not exist, since an unusual number of very different properties would require to be combined in the one material, says the *South African Journal of Industries*. Thus a good covering has not only to be a thoroughly efficient non-conductor of heat, but must be able to retain its cellular or other physical structure indefinitely under constant contact with the hot pipe or boiler plate, an extremely difficult matter. Also, it must be mechanically strong so as to remain in one position on the pipe under the influence of vibration and accidental external damage, and it must not be blown out of flange boxes when a joint leaks; further, it should have a low specific gravity so as not to place an undue weight on a long range of pipes.

Chemistry and Industry, the journal of the Society of Chemical Industry, observes that one material which is now coming into favor as a covering of a very high-grade character is blue asbestos, which has always found extensive use for locomotive work in the form of mattresses under the outer burnished metal cover.

Blue asbestos or crocidolite, which occurs only in South Africa, contains a considerable proportion of iron, and seems to be a complex ferrous and magnesium silicate with low moisture-content, and of a deep lavender blue in color. It possesses many advantages compared with the ordinary white varieties, the fibers being longer, averaging ¾ to 2 in., with a considerably higher tensile strength, and it has a lower specific gravity and is much more resistant to high temperatures. As shown by the National Physical Laboratory tests, blue asbestos is one of the best practical non-conductors of heat, being about 20 per cent better than white.

Increased Steam Pressures for Passenger Ships

Harold Yarrow, head of the shipbuilding firm of that name, London, Eng., announced a challenge of steam to the motor ship at a meeting of naval architects recently and reported in the *Christian Science Monitor*. A new system which greatly increases the steam pressure of the boiler is about to be tested in a passenger vessel now being built and which is expected to be ready in about three months. The cost of boilers of this type is estimated at 15 to 20 per cent more than hitherto, but this is offset by the higher value of the steam produced. A small turbine takes the steam from the boilers at about 500 lb. per square inch, and expands it to 220 lb., after which the installation is the same with which all engineers are familiar.

Taylor Recommends Further Study of Inland Waterways

The report of Major General Harry Taylor, Chief of Engineers, on the "Preliminary Examination and Survey of a Waterway from the Great Lakes to the Hudson River," has been submitted to Congress. This report was made in compliance with an item in the River and Harbor Act approved March 3, 1925.

After reviewing the depth of channels in the Great Lakes system, summarizing the demand for the deeper waterway connecting the agricultural and industrial mid-western sections of the country, and stating the viewpoints of the contestants favoring the different routes the report says in part:

Consideration was given to three possible routes: From Oswego to the Hudson River, following in general the New York State Barge Canal but entering the Hudson at Albany, via Normans Kill; from Buffalo to the Hudson, following the general route of the Barge Canal; and from Lake Ontario, via the St. Lawrence River, Lake St. Francis and Lake Champlain to the Hudson. The Special Board considers the first route superior to the other two and its cost and traffic data are based thereon. For a 20-ft. waterway the estimated first cost is $449,000,000 for a 25-ft. waterway, $506,000,000. The annual charges would be $26,940,000 for the 20-ft. waterway and $30,360,000 for the 25-ft. waterway.

	20-Ft. Waterway	25-Ft. Waterway
First cost of Lake Ontario Hudson River Waterway	$449,000,000	$506,000,000
Interest during construction	90,000,000	101,000,000
Erie-Ontario canal	110,000,000	125,000,000
Deepening important lake harbors and channels (rough estimate)	.....	100,000,000

Even without taking into consideration the last three items in the above table, it is seen that the annual charges for either a 20-ft. or 25-ft. channel would materially exceed the estimated annual savings. The Special Board therefore concludes that the project would be economically unsound, and recommends against the construction of the waterway.

This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith. The Board recommends that the project be not now adopted. It feels that, before making a decision on the question of a deep-water outlet for the Great Lakes, Congress would wish to have before it data both on the routes terminating in the Hudson River, and on the alternative St. Lawrence route. The Board summarizes the principal apparent advantages and disadvantages of the two alternatives. It is not prepared at present to evaluate these, or to pass on the merits or demerits of the St. Lawrence route; but it points out that data thereon will shortly be available.

After due consideration of the above mentioned reports, I concur in the views of the Board of Engineers for Rivers and Harbors. Viewed broadly, the proposal now under discussion is one of two possibilities for a connection from the sea to the interior section of the nation adjoining the Great Lakes. The other possibility most frequently discussed is that of a combined power and navigation development on the St. Lawrence River. A report thereon will shortly be submitted by the Joint Board of Engineers on the St. Lawrence River provided for by Congress for the purpose. From the economic angle it would seem that Congress should possess full information on both routes before making a decision on a case involving such large expenditures and such far-reaching possibilities. The national defense angle, in my opinion, does not have a decisive bearing on the case, for the reasons summarized by the Special Board and the Board of Engineers for Rivers and Harbors.

I therefore recommend that the department be authorized to make a further study of the case and submit further report. Neither a definite time limit nor specific depth should be prescribed. If a further report is authorized it will be made as soon as the necessary data can be obtained and properly studied.

River Rouge Ford Plant Changes Name to Fordson

At the direction of Edsel B. Ford, president of the Ford Motor Co., the name of the River Rouge plant, described in *Power* in 1921, of the company has been changed to the Fordson plant.

This plant, probably the largest industrial center in the world, is located along the River Rouge and has borne the name of the river ever since it was established, about ten years ago. Recently the town of Springwells, in which the plant is loacted, voted to change its name to Fordson.

New Concrete Coating for Steel Increases Strength

Results of tests at the engineering experiment station at Ohio State University of a new method of applying concrete to new or old structural steel to strengthen it, are described as "highly satisfactory," by Prof. J. R. Shank of the department of engineering, one of the faculty members conducting the experiment.

The new process, which consists of applying a special concrete mixture under high pressure, was used on a 15-ft. section of a 24-in. beam taken from the steel section of a condemned Chicago bridge. The steel, which was badly corroded, was given the coating.

Twenty-eight days after under testing machines at the laboratory the beam failed to show any sign of breaking under a maximum stress of 255,000-lb. pressure, as contrasted with 110,000-lb. of resistance which the beam was rated as having when it was new.

Inventors of the new process had estimated the beam would withstand 240,000-lb. pressure after treatment.

Structural engineers from a number of railroads and manufacturing firms as well as university officials attended the tests, which will be continued another week.

Power Alcohol Experiments in Queensland

Certain chemical tests for the extraction of power alcohol from prickly pear under the formula of a southern investigator are, according to the *Industrial Australian*, being carried out in Brisbane under the supervision of the Queensland Government analyst and the Government agricultural chemist, but have not yet reached finality. It is understood that the inventor claims that a certain percentage of sugar and 2 per cent alcohol, or 5 per cent alcohol taking it by dehydration, can be obtained from the prickly pear. The manufacture of power alcohol from cassava on a commercial scale is being started at Sarnia, North Queensland.

Another Oswegatchie River Development Proposed

Negotiations under way which may lead to a considerable water power development in upper New York State were reported in the press on March 19. The site of the proposed development, the financing of which is now being discussed, is on the Oswegatchie River, in St. Lawrence County, near Gouverneur, and not far from Watertown.

The W. H. Loomis Talc Corp. which owns mines and mills at the point, has acquired large holdings upon which the proposed power plant is to be erected. A heavy fall of water, with ample room to protect the flow, is said to have been obtained, and pending plans call for the construction of a plant, transmission lines, etc.

Mills Contests Governor Smith's Power Ideas

In a speech delivered on March 26, before the University Club of Utica, Congressman Ogden L. Mills declared that a possible maximum reduction of only two and a half per cent in their electric bills is all consumers may expect if Governor Smith's plan for state power development is put into practice.

Mr. Mills said:

The oportunities for reducing the cost to the domestic consumer are very small indeed. Let us consider the water-power district of New York State, which includes everything north of Albany and the Mohawk Valley, and south and west of Syracuse. Here, during the year 1925, there were operated some 92 separate electric companies, where properties were interconnected and which were separated by stand-by steam plants furnishing nearly ten per cent of the total energy.

Of their total investment, the amount chargeable to production, including land and intangible assets, amounted to 43.91 per cent. The amount paid for interest and dividends on capital engaged in production amounted to 16 per cent. Even if interest charged paid by the state were one per cent less than similar charges paid by private companies, the most the consumer could obtain would be a reduction of two and a half per cent under the amount he is now paying.

Then there is the question of taxes. Removal of all taxes assignable to the generating plant would save the consumer a little over four per cent. This reduction would, of course, be counterbalanced by an increase in taxes generally. In 1924, for instance, in this particular area, taxes paid by the hydro-electric companies aggregated $5,562,600. The use of the tax-exempt privilege is simply a device to compel the taxpayers to assume the burden of furnishing cheaper service to the electrical consumer.

John Fritz Gold Medal Is Presented to E. D. Adams

The public ceremonies of the presentation of the John Fritz Gold Medal, awarded to Edward Dean Adams, the 83 year old engineer, scientist and financier, whose vision, courage and industry made possible at Niagara Falls the large hydro-electric power development, were held on the evening of March 30.

Before the presentation, there was a dinner of the Board of Awards and guests at the Engineer's Club, at which addresses were made by Charles F. Scott, of Yale University, L. B. Stillwell, chairman of the Engineering Foundation, and Dr. W. H. Onken, Jr., editor of *Electrical World*.

Mr. Scott brought out the fact that the history of the Niagara Falls Power Co. is the history of the pioneer of the hydro-electric system, a forerunner of the modern utility power service. It recorded, he said, the great step in the transition from mechanical to electrical power. He further stated, that the event of the nineteenth century was the great adventure of the world in power. By the engine of Watt the flow of falling rivers made mechanical power replace muscular power; the pulling of trains and the doing of miracles in industry by the vast multiplications of the power of the worker had thus created a new epoch in human history.

Mr. Stillwell made the point that there were in 1917, when we went into the war, only 20-million horsepower of power electrically generated, and that if the Niagara development had been delayed five years we would have had five million horsepower less when we needed it.

The presentation speech was made by Major Fred J. Miller, chairman of the committee which made the award. In his response Mr. Adams gave a brief history of the development of the power of Niagara Falls. Other speakers were James M. Beck and Professor Arthur Edwin Kennelly, of Harvard. Lieutenant Frank B. Jewett, chairman of the board of award, presided.

James M. Beck, Solicitor-General of the United States, deprecated the failure of the government to provide any system of rewards for its citizens of outstanding merit.

Professor Kennelly dwelt on the history of the Niagara Falls power development and declared that instead of disfiguring Niagara, the hydro development there had but diverted a part of its beauty, to transform it and deliver it to many thousands of persons in distant homes.

Cumberland River Project of 100,000 Kw. Planned

The Kentucky Hydro-Electric Co., of Louisville, Ky., has applied to the Federal Power Commission for a preliminary permit covering a proposed development on the Cumberland River above the mouth of Wolf Creek, in Russell County, Ky. It is proposed to build a concrete dam 220 ft. high. This will elevate the water so as to reach the tailwater elevation of the proposed development at Cumberland Falls. The plan is to install 100,000 kilowatts.

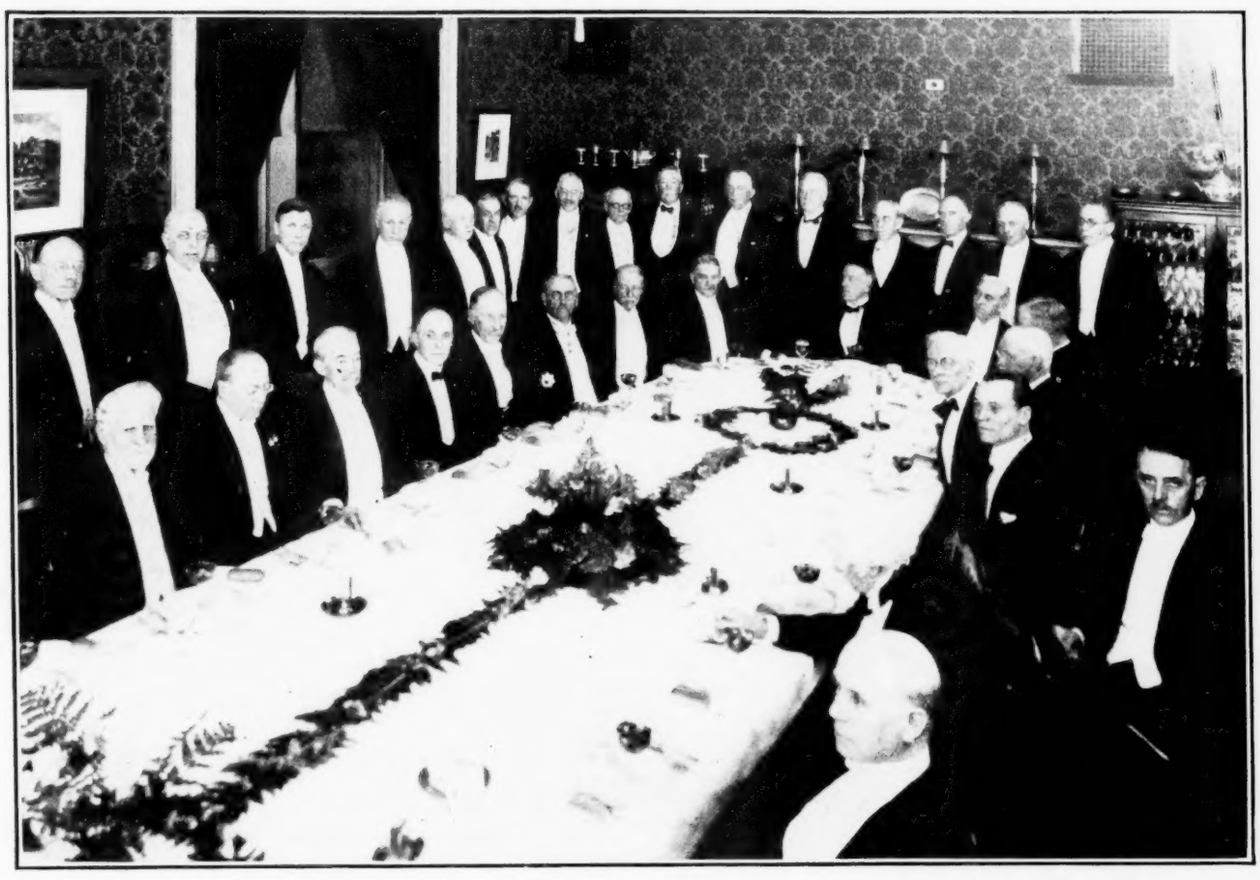
New River Project Thought To Affect Navigation

After a public hearing at which new data was developed, the Federal Power Commission has returned to the Chief of Engineers for further study his report on a proposed power development in New River near Radford, Va.

The Chief of Engineers has expressed the opinion that the project will not affect navigation in the Kanawha River, which has a large water-borne commerce. The members of the staff of the Federal Power Commission differ with this conclusion. They think the operating waves will interfere with the handling of the movable dams on the Kanawha and that the abrupt changes in the river stage will make navigation more difficult. The entire flow of New River could be used to advantage by the power company were it permitted to do so.

The staff of the Commission has no objection to the project, but thinks the development should come under the Water Power Act so that conditions many be placed in the license. Under the report of the Chief of Engineers the control of the project would rest with the state authorities in Virginia, while those likely to be damaged would be in West Virginia.

Something of an issue is being made of this case as the staff of the Power Commission feels that failure to secure jurisdiction in this case will establish a precedent under which a large number of projects will claim exemption from the requirements of the power act.



The John Fritz Medal Award Board and its dinner guests at the Engineers' Club in New York City

Four Colorado Oil Shale Plants Ready to Operate

There are now four shale-oil plants in Colorado ready for active service when conditions appear favorable for commercial operations, the *Engineering and Mining Journal-Press* reports. The four plants are the Ginet, the Brown, the Lamb and the Thompson-Beeler. The most notable feature in shale-oil development in Colorado during the last year, according to Victor C. Alderson, has been the interest shown by companies and individuals of high financial standing in acquiring title to oil-shale lands.

Two Pipe Specifications Suggested

At a recent meeting in Providence of the Subcommittee on Steel Pipe of the American Society for Testing Materials, a new plan of issuing steel pipe specifications was discussed. According to this plan the present Standard Specifications for Welded and Seamless Steel Pipe would be divided into two specifications, one covering the so-called standard pipe marketed principally through jobbers, and the other a pipe of special qualities suitable for bending, flanging and special purposes. The latter specifications are being drafted upon the basis of tightening the requirements in the present specifications and a number of revisions to this end were reported at the meeting. Progress is being made in the development of specifications for standard pipe.

Present Regime Favors Grand Falls Development

The policy of the new conservative government of the Canadian province of New Brunswick with regard to power development at Grand Falls on the St. John River, was recently outlined by Premier J. B. M. Baxter, who championed the case of private enterprise in opposition to government ownership. He announced that arrangements were now being entered into under which the International Paper Co. will develop Grand Falls under a policy such as that which has carried the province of Quebec along so prosperously in the march of industrial development.

Giving figures as to the quantity of power to be developed at Grand Falls in the initial development to be undertaken, the premier quoted reports from Chief Engineer S. R. Weston, of the New Brunswick Electric Power Commission, to show that when the water of the St. John River was at its lowest in 1924, an unusually unfavorable year, the maximum continuous horsepower would have been 41,000, while in the next worst year it would have been 50,000 horsepower.

Obligations called for 7,000 hp. to be reserved, he pointed out. The International Joint Waterways Commission had ruled that 2,000 hp. must be made available for use in the state of Maine and 5,000 hp. must be reserved for use in the province of Quebec, under the arrangement by which legislation permitted storage and other privileges in that province. Then there would be a reservation of 4,000 hp. for use of the people of New Brunswick. This means the reservation of a total of 11,000 hp.

Under the terms of the new agreement, 20,000 hp. is to be reserved for the Fraser companies. The International Paper Co. would also have sufficient power for the operation at the outset of a 200-ton newsprint plant.

Petroleum Production in February Increases

The production of crude petroleum in the United States for February, 1926, as compiled from pipe-line reports to the Bureau of Mines, amounted to 54,564,000 bbl., a daily average of 1,949,000 bbl. per day. This represents an increase over January production of 24,000 bbl. per day, or 1.2 per cent, practically all of which was in light oil.

Total stocks of crude petroleum east of California amounted to 287,542,000 bbl., a decrease during the month of about 4,000,000 barrels. Stocks of crude oil in the Oklahoma-Kansas-North Texas area fell off 3,000,000 bbl. during February. Stocks of refinable crude in California were increased 700,000 bbl. Stocks of heavy crude and fuel oil in California amounted to 86,268,000 bbl. as compared with the revised total for January of 86,979,000 bbl. Shipments of crude petroleum through the canal for the month of February increased 80 per cent but shipments of refined products fell off materially.

The daily average production of gas and fuel oils increased, yet stocks were again drawn on extensively. Stocks of this commodity east of California amounted to 900,670,000 gal. (21,445,000 bbl), a decrease during the month of over 75,000,000 gallons.

The production both of lubricants and wax held steady and stocks of both were again increased.

Personal Mention

Laurence R. Brush, formerly chief operating engineer with the Dayton Scale Co., Dayton, has accepted a position with the Coffield Tire Protector Co., Dayton, Ohio.

L. E. Dickinson has been appointed manager of the Mississippi River Power Co., a recent acquisition of the North American Co. Mr. Dickinson has been identified with the Keokuk plant since 1912.

G. B. Shawver, for five years manager of the Smith County, Tenn., Electric Co., now the Carthage division of the Tennessee Electric Power Co., has been made superintendent of state plants.

Robert D. McCarter, vice-president of Day & Zimmermann, Inc., engineers, of Philadelphia, will be in charge of the new Paris office which is being opened by this firm to make investigations, reports and valuations of industrial and public utilities abroad. Mr. McCarter has long been identified with international engineering work, as engineer and consulting engineer for the General Electric and Westinghouse companies in Europe and Russia.

R. C. Becker has been appointed superintendent of steam stations of the Puget Sound Power & Light Co., Seattle, Wash., and **E. J. Beery** has been appointed assistant to the general superintendent of power in the same company.

V. E. Todd, superintendent of the Fond du Lac plant of the Wisconsin Power & Light Co., has been transferred to Sheboygan in a similar capacity. **S. O. Biehl** has succeeded Mr. Todd at Fond du Lac.

Ralph E. Hall, formerly physical chemist, U. S. Bureau of Mines, has recently announced the founding of the Hall Laboratories, consultants on the application of recent discoveries to the elimination of scale and corrosion in steam plants, at 304 Ross St., Pittsburgh, Pa.

Victor J. Azbe of St. Louis, Mo., has recently enlarged his research and testing laboratories, now known as the Azbe Industrial Laboratories. At present they are equipped to make tests on power and industrial plants as well as various kinds of special testing and research work.

Andrew Kidd, Sr., chief engineer of the Burden Iron Co., Troy, New York, who has been an employee of this firm for 66 years, retired on April 1. Mr. Kidd is now nearly 83 years old and has served the firm in the capacity of chief engineer since 1882, this position coming to him as the result of 22 years of industrious and painstaking work.

Society Affairs

The New Haven Section of the A.S.M.E. will hear George A. Orrok speak on April 27 at a meeting to be held at the Mason Laboratory, on "Recent Developments in the Production of Power."

The Akron Section of the A.S.M.E. will have as the subject for the meeting which is to be held on April 7 at the Firestone Auditorium, "Pulverized Coal," with A. E. Douglas of the Fuller-Lehigh Co. as the speaker.

The Metropolitan Section of the A.S.M.E. will have as the subject for its April 8 meeting "Limiting Factors in Reducing Excess in Steam Boiler Furnaces," by E. G. Bailey, president of the Bailey Meter Co.

The Providence Section of the A.S.M.E. will have as the attraction for the meeting at the Providence Engineering Society on April 9, "Boiler Room Efficiency in Industrial Plants," by Pell W. Foster, Jr., of the Power Specialty Co.

The Association of Mechanical & Electrical Engineers of Porto Rico have recently been entertaining Calvin W. Rice, the secretary of the A.S.M.E., who has been down there speaking before the Student Branch of the A.S.M.E. at the College of Agriculture and Mechanic Arts at Mayaguez and other organizations. Numerous luncheon and evening meetings were held, during the days between March 18 and 24, at which Mr. Rice was the principal speaker.

The Worcester Section of the A.S.M.E. will hold its April 8 meeting at the Worcester Electric Light Hall jointly with the A.S.S.T. and A.I.E.E. The subject will be "Mixed Gas Arc Welding," with Mr. Alexander as speaker.

The Pittsburgh Section of the A.S.M.E. will hold a joint meeting with the mechanical section of the Engineers Society of Western Pennsylvania on April 7 at the William Penn Hotel. "Automatic Control of Combustion," by T. A. Peebles, chief engineer of the Hagan Corp., will be the attraction.

Business Notes

The Foxboro Co., Inc., Foxboro, Mass., announces the removal of its Chicago office to rooms 204-6 St. Clair Bldg., 154 East Erie St., Chicago, Ill. C. H. Roessner continues in charge.

John A. Stevens, consulting engineer on the power problems of all industries, will, after April 1, be located in the building of the Lowell Institution for Savings, 16 Shattuck St., Lowell, Mass.

Warren Webster & Co., Camden, N. J., announce the appointment of Leon G. Gauvain, care of the Y. M. C. A., Buffalo, N. Y., as the company's resident engineer for Buffalo and vicinity.

The Johns-Pratt Co., Hartford, Conn., has recently elected Dwight G. Phelps, formerly sales manager of the Colt's Patent Fire Arms Mfg. Co., vice-president in charge of sales. Samuel M. Stone remains as president of the company.

The Wm. Powell Co., Cincinnati, Ohio, manufacturers of valves, according to an announcement of its directors has elected H. H. Coombe, president and treasurer, James Coombe, vice-president and general manager, and Geo. E. Weitkamp secretary of the company.

Maxted & Knott, Ltd., 23 Queen Anne's Gate, Westminister, S.W. 1, London, England, announces changes in its organization: F. Knott, one of the founders has decided to retire from active service and E. G. Walker has joined the firm which is now composed of G. V. Maxted, E. G. Walker and G. V. J. Maxted. In addition to all classes of structural work, waterways etc., the firm constructs power plants and engages in the general practice of mechanical and civil engineering.

Trade Catalogs

Boilers—The Casey-Hedges Co., Chattanooga, Tenn. The multi-pass water-tube boiler manufactured by this company as well as the C-H semi-vertical, drum and cross-drum water-tube boilers, return tubular and internally fired boilers are described in a well-illustrated catalog of 42 pages recently published by this firm.

Tester, Water—James G. Biddle, 1211 Arch St., Philadelphia, Pa. The "Dionic" water tester, a portable direct-reading instrument for testing condenser leakage and boiler water is described in Bulletin 1125 which has recently been issued by the company. It contains informative material on the practical uses of the tester as well as illustrations.

Tachometers—James G. Biddle, 1211 Arch St., Philadelphia, Pa. "Frahm Vibrating-Reed Tachometers," is the name of Catalog 1120, published recently by this firm. Pictures of the instruments as well as of installations are given.

Condensers, Static — The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Circular 1670-A, covering static condensers for power factor correction, contains descriptions, curves, charts and tables as well as pictures of this equipment. One part is devoted to a discussion of power factor and its correction and another part is devoted to low-voltage static condensers.

Coming Conventions

American Boiler Manufacturers Association. D. W. Glanzer, 840 Rockefeller Bldg., Cleveland, Ohio. Annual convention at Homestead, Hot Springs, Va., June 1-2.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Annual convention at White Sulphur Springs, W. Va., June 21-25.

American Refractories Institute, D. A. Texter, 2202 Oliver Bldg., Pittsburgh, Pa. Annual meeting at Bellevue-Stratford Hotel, Philadelphia, Pa. May 12.

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Regional meeting at Providence, R. I., May 3-6. Spring convention at San Francisco, Calif., June 28-30.

American Water Works Association. W. M. Niesley, Assistant to Sec., 170 Broadway, New York City. Annual convention at Hotel Statler, Buffalo, N. Y., June 7-12.

American Welding Society. M. M. Kelly, 29 West 39th St., New York City. Annual convention at 29 West 39th St., New York City, April 21-23.

Association of Iron & Steel Electrical Engineers. John F. Kelly, 1007 Empire Bldg., Pittsburgh, Pa. Exposition and convention at Hotel Sherman, Chicago, Ill., June 7-10.

International Electrotechnical Commission. F. V. Magalhees, 708 Fifth Ave., New York City. Meeting at 29 West 39 St., New York City, April 13-22.

Master Boiler Makers Association. Harry D. Vought, 26 Cortlandt St., New York City. Annual convention at the Statler Hotel, Buffalo, N. Y., May 25-26.

National Association of Stationary Engineers. F. W. Raven, 417 South Dearborn St., Chicago, Ill. Convention at Atlantic City, begins Sept. 14. Erroneously announced as Sept. 6-11. Annual conventions and exhibitions of state association are scheduled as follows: **Indiana State Association,** F. L. Clifford, 653 South Union St., Kokomo, Ind., Convention at Lafayette, Ind., May 10-15; **Kansas State Association.** H. S. Dukes, School for the Blind, Kansas City, Mo. Convention at Abilene, Kans., May 19-21; **Illinois State Association.** W. L. Hamilton, 719 Ninth St., Decatur, Ill. Convention at Decatur, Ill., June 2-4; **New England States Association.** Freeman L. Tyler, 32 Briggs St., Taunton, Mass. Convention at New Bedford, Mass., June 16-19; **Ohio State Association.** T. S. Garrett, 2622 E. Second St., Dayton, Ohio, Convention at Newark, Ohio, June 17-19; **Connecticut State Association,** George F. Klopfer, 30 East Pearl St., New Haven, Conn., Convention at Norwich, Conn., June 25-26; **Minnesota State Association.** C. A. Nelson, 800 22nd Ave., N. E. Minneapolis, Minn. Convention at Rochester, Minn., Aug. 4-6; **New Jersey State Association,** S. G. Dalrymple, 111 Hutton St., Jersey City, Convention at Atlantic City, Sept. 12; **Pennsylvania State Association,** Frank J. McCarron, 3647 North 11th St., Philadelphia, Convention at Philadelphia, Sept. 12-13.

National Board of Boiler and Pressure Vessel Inspectors. C. O. Myers, 14 Commercial National Bank Bldg., Columbus, Ohio. National Board meeting at Chicago, Ill., May 3-5.

National District Heating Association. D. L. Gaskill, Greenville, Ohio. Convention at Niagara Hotel, Niagara Falls, June 1-4.

National Electric Light Association. A. Jackson Marshall, 29 West 39th St., New York City. Forty-ninth convention and manufacturers' exhibition, at Atlantic City, Young's Million Dollar Pier, May 17-21.

Power Show. International Textile Exposition—James F. Morgan, 53 Devonshire St., Boston, Mass. Power Show will be Department "D" of the International Textile Exposition, and will be under the auspices of the New England Association of Commercial Engineers, and held at the Mechanics Bldg., Boston, Mass., April 12-17.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Mar. 29 1926
Pool 1	New York	$2.60@$2.95
Smokeless	Boston	1.54
Clearfield	Boston	1.80@ 2.10
Somerset	Boston	1.85@ 2.20
Kanawha	Columbus	1.40@ 1.70
Hocking	Columbus	1.35@ 1.70
Pittsburgh	Pittsburgh	2.00
Pittsburgh gas slack	Pittsburgh	1.40@ 1.50
Franklin, Ill.	Chicago	2.35@ 2.50
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.10@ 2.25
West Ky.	Louisville	1.15@ 1.50
S. E. Ky.	Louisville	1.25@ 1.60
Big Seam	Birmingham	1.75@ 2.25
Anthracite, Gross Tons		
Buckwheat No. 1.	New York	2.50@ 3.50
Buckwheat No. 1.	Philadelphia	3.00@ 3.50
Birdseye	New York	1.40@ 2.00

FUEL OIL

New York—Apr. 1, light oil, tank-car lots; 28@34 deg. Baumé, 5½c. per gal.; 36@40 deg., 6c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Mar. 23, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2 per bbl.; 26@28 deg., $2.05 per bbl.; 28@30 deg., $2.10 per bbl.; 30@32 deg., $2.15 per bbl.; 32@36 deg., gas oil, 5.8c. per gal.; 38@40 deg., 6.5c. per gal.

Pittsburgh—Mar. 24, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6¼c. per gal.

Dallas—Mar. 27, f.o.b. local refinery 26@30 deg., $1.65 per bbl.

Philadelphia—Mar. 24, 27@30 deg., $2.31@$2.37 per bbl.; 18@22 deg., $1.93@$1.99; 13@19 deg., $1.74@$1.80 per bbl.

Cincinnati—Mar. 30, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6¼c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Mar. 30, tank-car lots, f o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.25@$1.35 per bbl.; 26@30 deg., $1.35@$1.45; 30@32 deg., $1.65.

Boston—Mar. 29, tank car lots, f.o.b.; 12@14 deg. Baumé, 6c. per gal.; 28@32, deg., 4.65c. per gal.

New and Improved Equipment

California — Feather River Power Co., Hobart Bldg., San Francisco, awarded contracts for power plant equipment, for Bucks Creek power project on Feather River to General Electric Co., Rialto Bldg., San Francisco and Pelton Water Wheel Co., 1919 19th St., San Francisco, approximately $1,000,000; also 3,500 ton steel penstocks to Western Pipe & Steel Co., 444 Market St., San Francisco, $750,000.

Calif., Burbank—City plans an election to vote $150,000 bonds for the construction of additional pumping plants and reservoirs.

Calif., Burbank—First National Pictures Inc., 918 South Olive St., Los Angeles awarded contract for the construction of a motion picture studio including power plant, etc. here, to The Austin Co., 777 East Washington St., Los Angeles. Estimated cost $500,000.

Calif., Garden Grove — Orange County Waterworks Dist. No. 3, is having plans prepared for a deep well, booster pumping plants and a 125,000 gal. tank on 95 ft. tower. W. K. Hillyard, Court House, Santa Ana, is engineer.

Calif., Glendale—Glendale Ice Co., O. D. Betts, Gen. Mgr., awarded contract for extensions to ice plant to increase the capacity from 20,000 to 40,000 ton annually to Gay Engineering Co., 2650 Santa Fe St., Los Angeles.

Calif., Taft — Taft Union High School Dist., H. E. Osburn, Clk., will receive bids until April 13 for a 5 g.p.m. gasoline pump and 500 gal. tank.

Conn., Hartford — G. W. Morris, 804 Farmington Ave., awarded contract for the construction of a 10 story apartment to E. Morris, 804 Farmington Ave. Estimated cost $1,500,000.

Conn., Windsor Locks — Northern Connecticut Power Co., c/o J. G. White Engineering Corp., 43 Exchange Place, New York, N. Y., Engrs., is having preliminary plans prepared for the construction of a power plant here. Estimated cost $200,000.

D. C., Washington—City Central Corp., c/o T. W. Lamb, 644 8th Ave., New York, N. Y., Archt., is having plans prepared for the construction of a hotel and stores building at 10th and D Sts. here. Estimated cost $1,500,000.

D. C., Washington—O. H. Miller, McLachlen, Bank Bldg., Archt., will receive bids until April 12 for the construction of an 8 story carpenters' office and store building including oil burning equipment, ice plant, 2 passenger elevators, etc. at 10th and K Sts. N. W. for United Brotherhood of Carpenters and Joiners of America, Local No. 132, C. H. Adams, 3400 Eastern Ave., Mt. Rainer, Md., Chn. of Building Committee.

Ill., Chicago—C. F. Aaron, 139 North Clark St., is having plans prepared for the construction of a 7 story office and stores building at West Madison St. and Crawford Ave. Estimated cost $1,000,000. H. L. Newhouse, 4623 Drexel Ave., is architect.

Ill., Chicago—Childs & Smith, 720 North Michigan Ave., Archts., will soon receive bids for the construction of an 18 story apartment at Lake Shore Drive and Burton Place for Baird & Warner, 134 South La Salle St. Estimated cost $2,000,000.

Ill., Chicago—Harvey & Dammarell, 628 West Madison St., is having preliminary sketches made for the construction of a 12 story hotel at West Madison and Desplaines Sts. Estimated cost $1,000,000. A. S. Alschuler, 28 East Jackson Blvd., is architect.

Ill., Chicago—Syndicate, c/o Oman & Lilienthal, 64 West Randolph St., Archts., is having plans prepared for the construction of a 17 story apartment including oil burning system, electrical refrigeration, elevators, incinerators, etc. at 2130-2132 Lincoln Park W. Estimated cost $1,300,000.

Ind., Evansville—Bd. of Education, plans the installation of an air compressor, motor generator, down draft boiler, centrifugal vacuum and boiler feed pumps, 16,000 sq.ft. capacity, etc. in Francis J. Reitz High School. C. L. Troutman, 410 American Trust Bldg., is engineer.

Mass., Boston—J. R. Whipple Corp., Federal St., is receiving bids for the construction of a 15 story hotel at Tremont and School Sts. Estimated cost $3,000,000. Desmond & Lord, 1 Beacon St., are architects. J. R. Worcester Co., 79 Milk St., is engineer.

Mass., Cambridge (Boston P. O.)—Cambridge Electric Light Co., awarded contract for extensions and alterations to power house to H. R. Kent & Co., 5 Erie Ave., Rutherford, N. J.

Mich., Detroit—Consolidated Paper Co., 1338 Clay Ave., plans the construction of a plant for manufacture of paper and paper products on Telegraph Road. Complete electrical equipment will be required. Estimated cost $400,000. Private plans.

Mich., Detroit—Detroit Properties Co., E. A. Loveley, Washington Blvd. Bldg., had plans prepared for the construction of a 20 story hotel including steam heating plant on Bagley Ave. Estimated cost $6,500,000. C. W. & G. L. Rapp, 1749 Howard St., Chicago, Ill., are architects.

Mo., Marshall—City will receive bids until April 12 for the installation of a 750 g.p.m. 200 ft. head triplex centrifugal motor driven pump and 150,000 gal. tank on 140 ft. tower. Henrici-Lowry Engineering Co., 401 Security Bldg., Kansas City, is engineer.

Mo., St. Louis—W. Boges, 1920 Clara Ave., is in the market for a 40 to 80 hp. marine type engine, two or more cylinders.

Mo., St. Louis—Syndicate, c/o P. J. Bradshaw, International Life Bldg., Archt., plans the construction of a 20 story apartment at Lindell St. and Spring Ave. Estimated cost $5,000,000.

Mo., Washington — City plans improvements to pumping station including new motor driven centrifugal pumps, flow meters, etc. W. S. Merkle, 414 North 12th St., St. Louis, is engineer.

Neb., Omaha—Nebraska Power Co., 17th and Harney Sts., is having plans prepared for the construction of a power sub-station including transformers, voltage regulators, switches, switchboards, etc. at 52nd and Erskine Sts. Total estimated cost $65,000.

N. J., Atlantic City—F. P. Cooks Sons, will soon award contract for the construction of a 13 story hotel on Pennsylvania Ave. Lockwood, Greene & Co., 24 Federal Bldg., Boston, Mass., are architects.

N. Y., Astoria—Boas Realty & Construction Corp., c/o Gronenberg & Leuchtag, Bricken Bldg., Broadway and 38th St., New York, Archts., will build an apartment on Pierce Ave. here by day labor. Estimated cost $500,000.

N. Y., Brooklyn—Lutheran Hospital, East New York Ave., is having plans prepared for the construction of a power house and addition to hospital. Estimated cost $700,000. R. Rester, 41 East 42nd St., New York, is architect and engineer.

N. Y., Brooklyn — St. Johns Hospital, Atlantic Ave., is having plans prepared for the construction of a 5 story hospital at Atlantic and Albany Aves. Estimated cost $1,500,000. Lord & Hewlett, 2 West 45th St., New York, are architects.

N. Y., Buffalo—Buffalo Federation of Women's Clubs, c/o Plumber & Mann, Inc., 700 Main St., Archt., is having plans prepared for the construction of a 7 story club house including refrigeration and heating plant, swimming pool, etc. Estimated cost $1,000,000.

N. Y., Elmira—United Gas & Electric Co., 111 Broadway, New York, is having preliminary plans prepared for the construction of a power plant, here. Estimated cost $1,500,000. Private plans.

N. Y., New York—A. Wilson, c/o Sloane & Robertson, 441 Lexington Ave., Archts., is having plans prepared for the construction of an office building at 284 Madison Ave. Estimated cost $900,000.

N. C., Highlands—J. J. Smith, Mayor and Bd. of Aldermen, will receive bids until April 14 for the construction of a hydro-electric plant including power house, dam, 2 sub-stations, etc. W. H. Booker, Charlotte, is engineer.

O., Cleveland—Wilbur, Watson & Associates, 4614 Prospect Ave., Archts., will receive bids until April 17 for the construction of a 3 story mechanical engineering building including two 320 hp. water-tube boilers, stokers, fans, coal and ash handling equipment, generating equipment, switchboard, etc., for Case School of Applied Science. C. H. Howe, Pres. Estimated cost $200,000.

O., Gallipolis—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, awarded contract for the construction of addition to power house for State Institution for Epileptics, here, to R. B. Childs, Findlay, O. $37,000.

O., Mansfield—Richland Hotel Co., W. B. Martin, Chn. of Building Committee, will soon award contract for the construction of an 8 story hotel including steam heating system. Estimated cost $600,000. Schenck & Williams, Mutual Home Bldg., Dayton, and V. Redding & Associates, Bird Bldg., Mansfield, are associate architects.

Okla., Wewoka—City is in the market for a 500 g.p.m. two stage centrifugal pump driven by a 75 hp. marine type gasoline engine.

Tenn., Lewisburg—Southern Cities Power Co., Columbia, has acquired a site and plans the construction of a 2,000 kw. hydro-electric plant 12 miles north of here. Engineer not selected.

Tex., Alice—Texas Central Power Co., Frost Bldg., San Antonio, plans extensions to ice plant here. Estimated cost $20,000. Private plans. Ice-making and refrigeration machinery will be required.

Tex., Amarillo—A. J. Thompson Products Co., c/o H. Bartlett, Mgr., awarded contract for the construction of a produce house including cold storage plant on Grant St. to Fred Bone Construction Co. Estimated cost $40,000.

Tex., Del Rio—Texas Central Power Co., Frost Bldg., San Antonio, is having surveys made for the construction of a large power dam on Devil's River to supply hydro-electric energy to surrounding farms and ranches. Estimated cost $250,000. Private plans.

Tex., New Braunfels—E. A. Clousnitzen, Kenedy, has acquired the Citizens Ice & Cold Storage Co.'s plant and is having preliminary plans prepared for improvements to increase the capacity from 10 to 30 ton. Estimated cost $50,000. Private plans. Owner is in the market for machinery.

Tex., Panhandle—Holcroft & Simpson, Wynona, Okla., plans the construction of a 200 ton ice plant. Estimated cost $200,000. Private plans. Machinery will be required.

Tex., Raymondville—Willacy Gin Co., is having plans prepared for the construction of a long staple gin plant including electrically driven machinery, 6 stand 80 saw capacity. Estimated cost $40,000. Private plans.

Tex., San Antonio—Texas Central Power Co., Frost Bldg., plans the installation of electric power for irrigation of 5,000 acres in Wharton County and 15,000 acres in Colorado County. Estimated cost $200,000. Private plans.

Vt., Bellows Falls—New England Power Co., 35 Harvard St., Worcester, awarded contract for the construction of a power development, 15,000 to 35,000 hp. capacity to Power Construction & Engineering Corp., 35 Harvard St., Worcester. Estimated cost $3,000,000.

Ont., Thistletown — Hospital for Sick Children, College St., Toronto, is having plans prepared for the construction of a 2 and 3 story hospital including steam heating and ventilation systems, here. Estimated cost $500,000. Sproatt & Raph, 1162 Bay St., Toronto, are architects.

N. S., Halifax — J. W. Norcross, 65 Victoria St., Montreal, Que., will soon receive bids for the construction of a cold storage plant here. Estimated cost $2,000,000. In the market for equipment.

H. I., Peak Harbor—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the installation of motor generator sets here.